

Theory of Mind and Communication in Autism

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A.M.D.G.

Abstract

Recent work investigating the biological and cognitive nature of autism is reviewed. The hypothesis that autistic individuals suffer from a specific impairment in theory of mind, and the relevance of this notion to the diagnosis of Asperger's syndrome, is discussed. Theory of mind explanations of autism must account for the minority of autistic subjects who pass false belief tasks. Two possible accounts are considered; delay versus "hacking". A battery of theory of mind tasks was given to able autistic subjects, and to mentally handicapped and young normal controls. The results suggested the existence of subgroups: while some autistic subjects performed inconsistently (perhaps using task-specific strategies), others performed consistently well at first-order theory of mind tasks, and some passed an array of second-order tasks.

Relevance theory suggests that understanding mental states is vital in communication. Communication tasks were therefore given, to explore the theory of mind abilities of the autistic subjects. Relevance theory predicted that subjects unable to attribute mental states would show literal understanding, subjects with first-order theory of mind would comprehend metaphor, but second-order theory of mind would be necessary to understand irony. These predictions were tested and confirmed with autistic subjects and normal children.

The theory of mind hypothesis cannot explain the persistent real-life handicaps of autistics who understand mental states, nor account for the nonsocial peculiarities seen in autism. A deficit in central coherence is suggested as the source of these features. Results from a preliminary test of this hypothesis suggested that even autistic subjects who develop theory of mind ability are impaired at extracting context-dependent meaning.

The implications of these findings for the diagnosis of Asperger's syndrome, the relations between the social and nonsocial impairments, and suggestions for further research are discussed.

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Chapter 1

Autism and Theory of Mind

In this chapter the growing body of work on the nature of autism is discussed. Research at the biological and behavioural levels is reviewed, but it is the level which connects brain to behaviour that is the focus here - that is, the level of cognition. One particular cognitive theory of autism is presented, which suggests that the fundamental deficit in autism is a failure to represent mental states, and to attribute these propositional attitudes to self and others. After looking at some of the issues involved in postulating such a deficit, the challenge posed to this theory by the most able autistic individuals (considered further in chapter 2) is discussed - framing the research question addressed in the experimental work which follows.

Autism is a developmental disorder affecting between 4 and 10 in every 10,000 children born (Lotter, 1966; Bryson, Clark & Smith, 1988; Steffenberg & Gillberg, 1986). Kanner (1943) first described and named the disorder, and then, as now, autism was defined on the basis of behaviour. For Kanner, the essential and defining symptoms of autism were the child's "autistic aloneness" and "obsessive desire for the preservation of sameness" (Kanner & Eisenberg, 1956). Although Kanner's early descriptions were very evocative, and many of the autistic children we see now conform exactly to the picture he drew, the diagnosis of autism has changed in a number of ways as more has been learnt about the disorder.

Necessary and Sufficient Features

Since Kanner's initial insight was based on a limited number of cases referred to his clinic, his description naturally included some features that are secondary to, or even unrelated to, autism. The starting point for progress in discovering the nature and cause of autism, was built in turn on a wealth of epidemiological and clinical data that has allowed the stripping away of those symptoms which, while being

shown by some autistic children, are not symptoms of autism itself. Without such a "cleaning up" process, attempts at explanation would be unlikely to succeed, since researchers would stand a good chance of spending time trying to explain features that are in fact neither universal nor specific to autism. In the past, effort has sadly been wasted in just such a way, and such non-necessary features have even been suggested as causes of autism (eg. the stimulus overselectivity hypothesis of Lovaas, Schreibman, Koegel and Rehm, 1971).

Reviews of the epidemiological work conclude that, of the host of symptoms shown by autistic children, many are not specific to autism. So, for example, Wing and Wing (1971) found that while more than 80 percent of autistic children in their sample showed preference for the proximal senses, this preference was also seen in 87 percent of partially blind and deaf children, 47 percent of subjects with Down Syndrome and 28 percent of normal children. Since features such as language problems, stereo typies and mental retardation can be found in other, non-autistic, children they cannot be primary causes of the autistic child's other problems.

Similarly, while some children with autism avoid social contact, like Kanner's cases, others are merely passive, or even actively social in a peculiar fashion (Wing & Gould, 1979; Wing, 1988). The manifestation of autism has been found to vary across and even within individuals, according to intellectual ability and age. The picture that autism presents, then, varies greatly, and Wing (1988) introduced the concept of a **spectrum** of disorders in autism. However, there is an obvious problem with such heterogeneity of presentation in a disorder diagnosed on the basis of behaviour. This problem has been overcome by an appeal to the level of cognition. A whole array of different and diverse behaviours may be equated at the level of cognitive deficit, just as a number of very different physical reactions may be the result of a single underlying disease (eg. chicken pox). Similarly, the very different patterns of features presented by people with autism, have been explained as springing from one core cognitive deficit. In some sense, then, diagnosis of autism is behavioural, with insight from the level of cognition; autism is seen as a biologically caused but cognitively defined disorder (Frith, Morton & Leslie, 1991).

A further problem exists with claiming that one can diagnose autism meaningfully on the basis of behaviour. This is the criticism that the features may merely co-occur by chance, and that talk of autism as a syndrome is unjustified - rather it should be seen merely as an unlucky assortment of handicaps with no common cause. The fundamental work in answering this criticism was done by Wing and Gould (1979) who conducted an epidemiological survey of all children living in the Camberwell area. From the total population aged under 15 years (35,000), all children (914) known to the social, educational or health services were screened. Children were selected from this group if they were functioning at the severely retarded level, and/or if they showed one of the following; social impairment, verbal and nonverbal language impairment, repetitive/stereotyped activities. The screening resulted in a group of 132 children (with nonmobile children excluded), all of whom attended special schools, and who ranged in age from 2 to 18 years. The children were observed and given medical and psychological tests, and their carers were interviewed with the Handicap, Behaviour and Skills Schedule (Wing & Gould, 1978). The group was divided on the basis of social behaviour into 58 children with appropriate social interaction (for their MA) and 74 socially impaired subjects (of whom 17 were classically autistic, by Kanner and Eisenberg's (1956) criteria of social aloofness and elaborate routines). The groups did not differ significantly in age, but there were significantly more males in the impaired group than the sociable group. In addition there were significant differences in communicative and play behaviours in the two groups; 90 percent of the impaired group (versus only 50 percent of the sociable subjects) were either mute or echolalic at the time of parental interview, and 97 percent of the impaired group (versus 24 percent of the sociable group) showed no or only repetitive symbolic play. In the sociable group, all subjects showed symbolic play except those with a language comprehension age below 20 months - a mental age below which pretence would not be expected, since normal children only manifest this ability in the second year of life. By contrast, the socially impaired subjects with language comprehension age over 20 months still showed language deficits and poverty of symbolic play. Wing and Gould concluded that "all the children with social impairments had repetitive stereotyped behaviour and almost all had absence or abnormalities of language and symbolic activities. Thus the study showed a marked tendency for these problems to occur together" (p.25). This association between deficits in

socialisation, communication and imagination was also found in a group of 761 adults in a mental handicap hospital; abnormal speech was shown by 75 percent of those with social impairment, versus 14 percent of those showing social interaction appropriate for their mental age. Lack of symbolic activity - including lack of interest in books or films, concern for others, and MA-appropriate play - was found in 73 percent of the socially impaired group, and only 8 percent of the sociable group. The association also emerges if the Camberwell sample is divided on the basis of types of play shown (Wing, Gould, Yeates & Brierley, 1977) rather than social functioning.

Problems of **socialisation, communication and imagination** are sufficient and necessary to explain much of the behaviour found to be specific and universal to autism. An autistic person may have no speech or gesture whatsoever, they may be echolalic only, or they may have fluent but pragmatically deviant language - but all these variations can be seen as manifestations of a communication handicap. The autistic toddler may spin the wheels of a toy car instead of pretending to park or clean it, while the autistic adult shows no interest in fiction in the form of TV soaps or novels, preferring to read telephone directories: both of these pictures reflect an underlying impairment in imagination. Similarly, the autistic person may run away from social approaches, may seem cut off and passive, or may pester people with questions and monologues; but these behaviours all demonstrate a fundamental lack of social understanding (Wing, 1988).

This set of three core impairments, which has become known as Wing's triad (Wing, 1981b), is the basis for the diagnosis of autism today (Rutter & Schopler, 1987). Diagnosis of autism in both DSM-III-R (American Psychological Association, 1987) and ICD-10 (World Health Organisation, 1987) is based on three fundamental impairments which capture Wing's triad;

- Qualitative impairment in reciprocal social interaction,
- Qualitative impairment in verbal and nonverbal communication and in imaginative activity,
- Markedly restricted repertoire of activities and interests.

The triad of impairments in socialisation, communication and imagination also forms the background for research into autism, for it defines the problem to be solved and the picture to be explained. A minimum requirement for psychological theories of autism, then, is to explain the co-occurrence of these three deficits.

Explaining autism: Levels of description

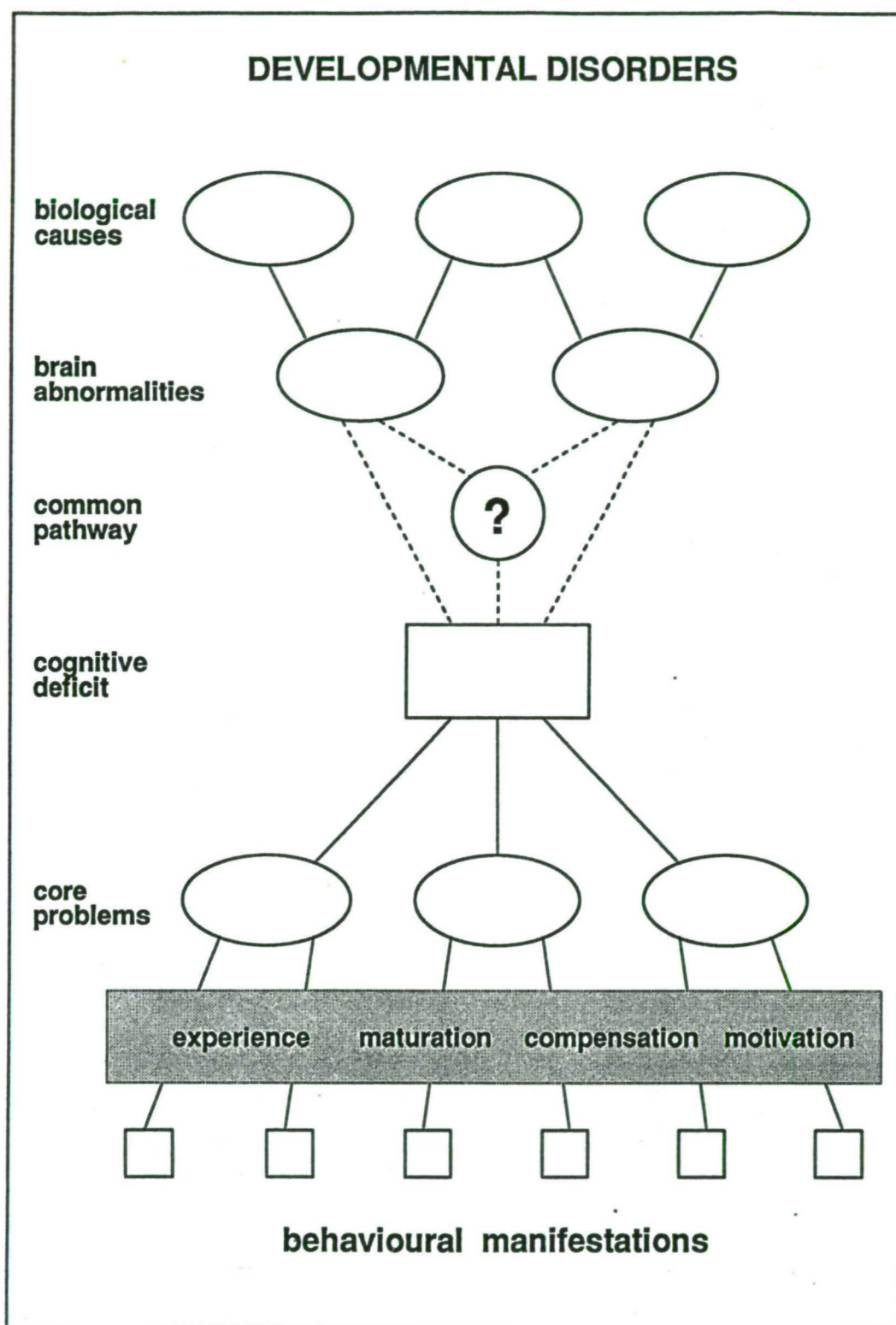


Figure 1.1 Levels of description; Biology, Cognition, Behaviour

An explanation may be thought of as a description at a deeper level. We have already seen how the diverse behaviours of autistic people can be made sense of in terms of three underlying impairments. These impairments in turn require explanation at a number of levels (figure 1.1); biological, genetic, cognitive.

Biology and brain

Bettelheim (1956, 1967) was the source of the "refrigerator mother" theory - the idea that children become autistic as a maladaptive response to a threatening and unloving environment. This idea was later taken up by Kanner, who believed he saw mild autistic features of detachment and social difficulty in the parents of the children he treated. Originally, however, Kanner had interpreted these traits as signs of a genetic component to autism (Kanner, 1943). This early insight has proved correct, while no evidence has emerged to support the psychogenic explanations of autism. Particularly damaging to such theories is the fact that cases of children who are mistreated to a horrifying degree and neglected almost entirely (eg. Curtiss, 1977), show that such a history does not give rise to autism, rather such children as Genie quickly made emotional ties with their nurses after being rescued.

Reviews of the biology of autism conclude that evidence for an organic cause is overwhelming (Gillberg, 1991; Schopler & Mesibov, 1987; Coleman & Gillberg, 1985). Some of the biological factors associated with autism are summarised in table 1.1. The high incidence of epilepsy in autistic children is just one indication of brain damage (Gillberg & Steffenberg, 1987). Another is the tendency for general mental retardation to accompany autism: around three quarters of all people with autism are also mentally retarded ($IQ < 70$), and as one looks at groups of the mentally handicapped with progressively lower IQ the incidence of autism increases (Smalley, Asarnow & Spence, 1988). This is easily explained if autism is caused by damage to a circumscribed brain region, X. Widespread damage to the brain, such as causes mental retardation, will be more likely to knock out the specific component X the more of the brain it affects. While no unambiguous and universal findings have emerged to suggest the site of the lesion, or the precise nature of the

neurochemical pathway disrupted in autism, we can be confident that autism has a primary cause at the level of the brain (Steffenberg & Gillberg, 1990).

Table 1.1

Summary of Biological factors in Autism

Signs of brain dysfunction:

Abnormally high incidence of epilepsy

Association with mental retardation

Abnormal nystagmus

Persistence of immature reflexes

Abnormal EEGs

Neurochemical abnormalities:

Raised blood serotonin levels

Abnormalities of the dopamine metabolism

Endorphin hyperfunction

Neuroanatomical Anomalies in:

Brainstem

Cerebellum

Vestibular areas

Temporal lobes

Prefrontal structures

Evidence for a genetic component to autism is weighty, although the exact role of the child's genes is far from clear (Rutter, Macdonald, LeCouteur, Harrington, Bolton & Bailey, 1990). The sex ratio in autism is suggestive: autism is more than twice as common in boys as in girls (Lotter, 1967). This ratio increases to 5:1 at the high ability end of the autism spectrum (Lord, Schopler & Revicki, 1982; Lord & Schopler, 1987). There is a significant familial loading for autism; autism is 50 times more frequent in the siblings of autistic people (Smalley et al, 1988).

Siblings who are not themselves autistic, show a much increased incidence of other cognitive impairments, such as language disorders (Bolton & Rutter, 1990; August, Stewart & Tsai, 1981) and social impairments (Macdonald, Rutter, Rios & Bolton, 1989). Monozygotic twins also have a far higher concordance for autism than dizygotic twins (Folstein & Rutter, 1977), showing that familial loading is not simply due to a mother's tendency to experience difficult pregnancies.

However, the concordance even in identical twins is not perfect, which suggests that there may be a genetic predisposition for autism, which is only fulfilled if triggered by pre- or perinatal difficulties. Mothers of autistic children report more problems during pregnancy and delivery than mothers of, for example, schizophrenics (Green, Campbell, Hardesty, Grega, Padron-Gayor, Shell & Erlenmeyer-Kimling, 1984). Folstein and Rutter (1977) also found that where monozygotic twins were discordant for autism, the autistic twin alone had experienced a difficult delivery. While it is possible that, for example, anoxia at birth may "tip the balance" for a child with a genetic predisposition for autism, it has also been suggested that the autistic child is already "different" as a developing foetus, and tends to cause its mother problems during delivery for this reason - the so called "harmless consequences" theory (Goodman, 1990). Another suggestion (DeLong & Dwyer, 1988) is that certain forms of autism may show a greater contribution from heredity than others: so Asperger's syndrome may be largely an inherited disorder, a suggestion receiving some support from widespread anecdotal reports of similar traits in the fathers of such patients (Eisenberg, 1957; Narayan, Moyes & Wolff, 1990). Van Krevelen (1971) went so far as to suggest that autism genes plus brain damage led to autism, while autism genes alone led to Asperger's syndrome. However, some clinicians (eg. Tantam, 1986) insist that an Asperger's syndrome pattern can be found at all IQ levels, and in cases of brain damage.

A general consensus at present, is that a number of rather different biological causes may result in autism (Coleman & Gillberg, 1985; Schopler & Mesibov, 1987). Fragile-X syndrome, phenylketonuria, and tuberous sclerosis all carry an increased risk of autism (Reiss, Feinstein & Rosenbaum, 1986; Gillberg & Forsell, 1984; Hunt & Dennis, 1987; Blomquist, Bohmna, Edvinsson, Gillberg, Gustavon, Holmgren & Wahlstrom, 1985). In some tragic cases, herpes simplex encephalitis has left in its

wake severely autistic behaviour in a previously normal adolescent (Gillberg, 1986) or adult (Gillberg, in press). It would seem then that we may think in terms of a 'final common pathway': all these different disorders and factors (birth trauma, genes, etc) may damage the same specific component of the brain, thus resulting in autism. We are still a long way from pin-pointing this area in the autistic brain, but it may be that we can specify what function is lost in the autistic mind.

Cognitive Explanations

If several symptoms co-occur reliably the most parsimonious explanation is that they are caused by the same underlying deficit. Impairments in socialisation, communication and imagination cohere (Wing and Gould, 1979). It has been suggested that a single cognitive deficit could underlie these three diverse features of autism.

According to Leslie (1987, 1988) pretence is the key to cracking this puzzle. The autistic child's failure to show pretend play is striking. Children who are abused may show social problems, children who are neglected may show an unwillingness to communicate, but normal children in such situations appear to embrace the world of imagination as a vital refuge (eg. the case of "Paul" in Bettelheim, 1955). Mentally handicapped children without autism (Wing et al, 1977; Beeghly, Weiss-Perry & Cicchetti, 1989), as well as congenitally blind children (Fraiberg, 1977; Rogers & Pulchalski, 1984), show MA-appropriate imaginative play. The autistic child's imagination handicap is rarely the feature that worries parents or teachers. And yet it should be, for the development of pretence in normal children demonstrates the emergence of a startling new cognitive capacity, on which are built many of the child's most important abilities.

As Leslie (1987) has pointed out, pretence is an extraordinarily complex behaviour to emerge so early in development. During the second year of life, just as the child is learning, for example, what a telephone is, that bananas are good to eat, and the names for these things, mother suddenly picks up a banana and holds it to her ear saying, "Look, mummy's on the telephone!". This is no way to teach the

child about bananas and telephones. The child should be upset, confused; instead he is delighted. Around eighteen months the normal child can understand and indulge in pretend play (Fein, 1981) - how is this possible without wrecking the child's encyclopedic world knowledge?

Leslie (1987, 1988) has suggested that in order to prevent "representational abuse" - the interference of pretence with real knowledge - the child must possess two types of representation. Pretence is, for Leslie, good evidence that the two year old has not only **primary representations** of things as they really are in the world (with a premium on accuracy and veridicality), but also **metarepresentations** which are used to capture pretending (and are not checked against the real world for accuracy). The term "metarepresentation" is borrowed from Pylyshyn (1978), who defines metarepresentational ability as the "ability to represent the representational relation itself". Leslie suggests that metarepresentations contain three elements:

Agent - Informational Relation - "Expression"

eg. Mother - Pretends - "this banana is a telephone".

The expression is placed in decoupling marks (" ") in Leslie's scheme to indicate that it is decoupled from (or segregated from) reality. In Leslie's "decoupler" model of pretence, three mechanisms work together to form metarepresentations: the "expression raiser" copies primary representations (eg. this banana is a banana) into decoupling marks; the "manipulator" then changes this copy (eg. to "this banana is a telephone"), and marks it as pretence; lastly, the "interpreter" regulates the use of the metarepresentation for pretend actions.

Wulff (1985) concluded from a review of the literature, that autistic children do not show pretence. This led Leslie to hypothesise that autistic individuals have a faulty decoupler. This would be a circular argument, except that Leslie has pointed out that metarepresentations are necessary for more than just pretence - they are vital for representing other "informational relations" or propositional attitudes, such as think, hope, intend, wish and believe. In fact, the properties of logical opacity that apply to mental states have a parallel in the pretend play of young children:

Logical Properties
of Propositional Attitudes

- 1) Referential opacity
- 2) Nonentailment of truth
- 3) Nonentailment of existence

Types of Pretend Play

- Object substitution
- Attribution of properties
- Imaginary objects

So just as to understand mother's pretend action a child must represent her informational relation to a decoupled expression, so to understand beliefs the child must represent the same three part relation, here the informational relation being not "pretends" but "believes".

This hypothesis generated a testable prediction, then, about the social handicap in autism. If autistic children do not show pretence because they lack/have a dysfunctional decoupler, then they should also be incapable of understanding mental states, since this too requires metarepresentations.

While it is clear that autistic children show social impairments, proving that they lack understanding of mental states requires a precise test. Research into the nature of the social deficit in autism has therefore been greatly helped by recent work on the normal development of social competence, and specifically the development of the child's so-called "theory of mind".

Theory of mind and the understanding of false belief

Research into theory of mind began with primates. Premack and Woodruff (1978) tested chimpanzees' ability to deceive a "bad" keeper in order to keep a reward for themselves. They hoped to be able to show in this way that the chimpanzee had

what they termed a "theory of mind" - the ability to impute independent mental states to self and others and to use these mental states to predict and explain behaviour. Although their methodology made it hard to interpret the results in terms of anything other than learning the means to a behavioural end, the discussion of their work gave rise to a consensus of opinion as to what would be a sound test of theory of mind. Dennett (1978) pointed out that only understanding and predicting a character's behaviour based on a false belief could show theory of mind conclusively, since otherwise the real state of affairs (or the subject's own convictions) could be appealed to without the need to postulate mental states at all. Such a strict test of the ability to represent mental states was exactly what was needed to test Leslie's metarepresentational theory of autism. However, it was first necessary to know how such ability develops in normal children. Only the failure of autistic subjects of a mental age in excess of the age at which normal children pass such tasks, would provide good support for Leslie's theory.

Wimmer and Perner (1983) took up Dennett's suggestion, and tested normal children on what has become a classic false belief task; Maxi has a chocolate and puts it in his box before he goes out to play. While he is out mother comes in and moves Maxi's chocolate from the box to the cupboard. Then Maxi comes back in from playing. Question: Where will Maxi look for his chocolate/think his chocolate is? Here, and in a number of replications (Perner, Leekam and Wimmer, 1987; Moses & Flavell, 1990; Leslie & Frith, 1988; Moore, Pure & Furrow, 1990; Perner, Frith, Leslie & Leekam, 1989), it was found that while four-year-olds correctly predicted that Maxi would expect the chocolate to be in the box where he left it, most three-year-olds said that he would look where the chocolate really was, that is they took no account of his false belief.

The three-year-old's difficulty with false belief is now fairly well established (for a recent review of this rapidly growing area, see Astington & Gopnik, 1991). In another task the child himself is the holder of a belief which is revealed to be false. In the "smarties task" (Perner, Leekam and Wimmer, 1987) the child is asked to guess what a closed smartie tube contains. Having answered "sweets" or "smarties" the tube is opened to show the real contents, a pencil. The lid is then replaced and the child asked, "When you first saw this box, before we took off the

lid, what did you think was inside?" In this task three-year-olds do not seem to recall their false belief but answer instead "a pencil" (Gopnik and Astington, 1988; Wimmer and Hartl, 1991). The same pattern emerges if the child is asked what another child, who has not seen inside the tube, will say when asked what is inside; three-year-olds expect a true belief while four-year-olds recognise the false belief.

Equipped, then, with a good test of the ability to represent mental states, Baron-Cohen, Leslie and Frith (1985) explored the prediction that autistic children lack a theory of mind. They tested 20 autistic children with MA's well over 4 years (mean nonverbal MA 9:3, VMA 5:5) on a variation of the "Maxi" story, the Sally-Ann task, and found that 80% (16/20) of these children failed to appreciate Sally's false belief. In contrast, 86% of Down Syndrome children (12/14) of rather lower mental age (nonverbal 5:11, VMA 2:11) succeeded on the task. This finding has now been replicated in a number of studies, using real people instead of toys, using a "think" question rather than a "look" question, and using a control group of specifically-language-impaired children to rule out a language deficit explanation (Leslie and Frith, 1988; Perner et al, 1989). Autistic children have been shown to fail other false belief tasks, such as the smartie tube task (Perner et al, 1989), and a picture sequencing task (Baron-Cohen, Leslie and Frith, 1986). Table 1.2 lists the studies relevant to this area.

Table 1.2

Studies relevant to Theory of Mind in Autism (*=failure to replicate usual autistic theory of mind failure)		
<u>Date</u>	<u>Authors</u>	<u>Relevant Results</u>
1985	Baron-Cohen, Leslie & Frith	Most autistic subjects fail a first-order false belief task (Sally-Ann)
1986	Baron-Cohen, Leslie & Frith	Autistics show selective problems sequencing "intentional" story pictures
1987	Dawson & Fernald	Autistics are impaired in "conceptual perspective taking"; cannot choose gifts appropriate for different people
1988	Harris & Muncer	Autistics find "false" desires as hard as false beliefs
1988	Leslie & Frith	Autistics understand seeing but not knowing or believing (even tested with real actors, not puppets)
1988	Riviere & Castellanos	Autistics fail Sally-Ann task
1989	Perner et al	Autistics fail "smarties" test of false belief, cannot infer knowledge from perceptual access, and fail to communicate preferentially information unknown to hearer. Controls were specific-language-impaired children
1989	Baron-Cohen(a)	Even those autistics who pass first-order false belief tasks, fail a second-order false belief task
1989*	Baron-Cohen(b)	More than half the autistics correctly predicted a character's emotional reaction to fulfilled/unfulfilled desires
1989	Baron-Cohen(d)	Autistics fail to distinguish mental vs. physical entities, appearance vs. reality, and the mental functions of the brain
1989*	Bowler	A group of "Asperger's syndrome" subjects do as well on second-order false belief as normal controls
1989*	Oswald & Ollendick	Autistics not significantly worse than MLD controls on picture sequencing or

	Sally-Ann tasks, but worse on a "Hide the penny" game
1990 Baron-Cohen & Charman	Autistics fail Sally-Ann Task but pass a "false" drawing task
1990* Hughes & Russell	Autistics are bad at the "windows" task even with no opponent to deceive
1990 Nunez & Riviere	Autistics fail Sally-Ann task
1990* Prior, Dahlstrom & Squires	Autistics only significantly different on Sally-Ann task, not on "smarties" or "Sally-Ann" with people
1990 Reed & Peterson	Autistics fail both ignorance and false belief questions (Sally-Ann)
1990* Tan & Harris	Autistics recall correctly their own past, unfulfilled desires
1991 Baron-Cohen	Autistics show specific deficits in understanding only those emotions caused by false beliefs
1991 Eisenmajer & Prior	Most autistics fail a Sally-Ann task; half of those who fail, pass if question includes "look first" wording
1991 Russell et al	Autistics fail "windows" task
In press Leekam & Perner	Autistics fail Sally-Ann task but pass "false" photo task
In press Leslie & Thaiss	Autistic subjects fail Sally-Ann task but pass "false" photo task
In press Ozonoff, Pennington & Rogers	High-functioning autistics are impaired on Sally-Ann, mental vs. physical, appearance/reality, second-order false belief, and mental function of brain tasks. No worse, however, at picture-sequencing
In press Ozonoff, Rogers & Pennington	High-functioning autistic, but not "Asperger's syndrome" subjects show second-order false belief impairments
In press Sodian & Frith	Autistics can sabotage but not deceive a competitor, and cannot attribute a false belief

As can be seen, most studies have replicated the failure of a majority of autistic subjects on tests of false belief understanding. Different levels of ability, and in particular of verbal ability, may explain in part the differences in the size of this majority - for example in the study by Prior et al (1990), where only half of the autistic sample failed the Sally-Ann task (with actors). Many of the failures to replicate the theory of mind failure can be explained as due to the special nature of desires as mental states which can be grasped at a lower, non-propositional level (see p.37). In addition, there have been some failures to replicate theory of mind problems in the picture sequencing task - suggesting that this is not a pure test of understanding of mental states. Still other studies have attacked the theory of mind hypothesis on the basis of findings that some autistic subjects pass even second-order theory of mind tasks (Bowler, 1989 and Ozonoff et al, in press). This finding is the focus of the experimental investigations which follow in chapter 3, and elsewhere (p.40) the argument is given for why such success does not invalidate the theory of mind deficit hypothesis. Lastly, Hughes and Russell's (1990) finding - that autistic subjects find the "windows" task as hard without a competitor as with - is challenging for theory of mind deficit explanations of the autistic inability to deceive. However, the logic behind their conclusion (that if found equally hard the element of deception itself is not the problem for the autistics) only holds if the two tasks are otherwise equated for difficulty. As it was, the no-opponent task was certainly less natural, and indeed, the mentally handicapped controls in this experiment performed worse on the no-opponent than on the opponent task. To sum up, then, there is a substantial body of work in support of the hypothesis that autistic subjects have difficulty in attributing (false) mental states to themselves and others - a body of work which rival theories of autism must address.

The metarepresentational deficit theory of autism

Could the capacity to form metarepresentations be the single cognitive component at fault in autism? Leslie has suggested that the ability to metarepresent takes the form of an innately specified module. Could it be that the symptoms of autism follow from the lack of such a module? Certainly, an inability to form

metarepresentations, and the consequent inability to reflect on the mental states of self and others, would have far-reaching effects on behaviour. The triad of impairments seen in autism could well be due to such an inability to "mentalise" (Frith et al, 1991): the inability to pretend generated the model, the social impairment would follow from the lack of a theory of mind, and the characteristic communicative impairments would follow from an inability to represent intentions, or recognise utterances as interpretations of speaker's thoughts (see chapter 5).

However, such a conclusion is far from unanimously embraced. The finding that most autistic children fail theory of mind tasks has been met with much the same barrage of methodological criticism that has been launched on behalf of normal three-year-olds, who also fail false belief tasks. Researchers have suggested that autistic failure is due to pragmatic difficulties with the "look" question (Eisenmajer & Prior, 1991), to perceptual salience of the real location (Russell, Mauthner, Sharpe & Tidswell, 1991; Hughes & Russell, 1990), or to lack of motivation to deceive (De Gelder, 1987). Most such criticisms do not address the finding that autistic children fail a whole array of false belief tasks, with very different controls and methodologies. For example, in a recent study by Sodian and Frith (in press) autistic children's ability to keep a sweet from a puppet competitor by deception and by sabotage was examined. By contrasting these two conditions it was possible to rule out lack of motivation or failure to comprehend the instructions. The only difference between the two conditions was that deception (lying or pointing to the empty location) manipulated the competitor's beliefs, while sabotage (locking the box where the sweet was) simply manipulated his behaviour. The children also had to refrain from misleading or obstructing a co-operator who helped the child. In this experiment the autistic children proved surprisingly competent at sabotage but largely incapable of deception. Such well-designed experiments would appear to render explanations of autistic failure in terms of methodological artifacts untenable.

Those researchers who are satisfied that autistic subjects show a real failure on theory of mind tasks are hardly more in agreement than those who do not. One area of contention concerns how the lack of a theory of mind should be explained? As a result of a failure in a primitive emotional system? As a failure to form what

Leslie calls metarepresentations? Or as due to a failure to represent mental states in some other way?

Hobson, for example, has suggested that autistic children's lack of a theory of mind is merely a result of a more basic, **primary emotional deficit** in interpersonal relations (Hobson, 1986a,b; 1989). For him, then, the autistic child's problems are not caused by an inability to form metarepresentations, although this may be an important secondary consequence, but by an emotional deficit that leads to the child not receiving the necessary social experiences in infancy and childhood to develop the cognitive structures for social understanding. Hobson's own work has aimed at showing deficits in the autistic individual's ability to recognise emotional expressions. This work has recently been reviewed and criticised by Ozonoff, Pennington and Rogers (1990), who point out that significant deficits only emerge if controls matched on nonverbal IQ are used. The uneven IQ profile and superior performance scores of most autistic subjects make such matching procedures unreliable. Chapters 5 and 6 may give some indication of why matching subjects for verbal IQ might remove differences in emotion recognition, if these differences were due to a theory of mind deficit.

The problem with Hobson's theory is that it is hard either to prove or disprove - since the crux of the matter lies in causal priorities. Most symptoms of autism (eg. failure to recognise emotional expressions) could, in themselves, be explained by either a cognitive or affective primary deficit - and can be seen as either springing directly from such a deficit or developing as a secondary consequence. An attempt has been made to establish causal priority for emotional deficits by suggesting that autistic children show behavioural abnormalities before the age at which metarepresentational abilities emerge in normal children. Mundy and Sigman (1989) have argued that the fact that autistic children do not show joint attention behaviours, which develop prior to pretence in the normal child, proves that autism results from a deficit other than (and earlier than) an inability to metarepresent. However, this argument rests on the assumption that the emergence of pretence marks the emergence of metarepresentation. This, as Leslie and Happé (1989) have argued, is unlikely. While pretence is an early sign that metarepresentations must be available to the child, even earlier ostensive communication behaviours such as

joint attention may also signal the emergence of the ability to represent mental states, since these behaviours convey the intention to communicate something. Leslie and Happé discuss the possible mechanism which allows the young child to differentiate pretend and real acts, and relate this to the larger distinction between ostensive and non-ostensive behaviour. Sperber and Wilson (1986) suggest that ostensive behaviour is marked by two properties: it is attention-grabbing, and yet is irrelevant in itself, thus forcing the observer to recognise the actor's intended meaning. Pretence and joint attention behaviours fulfil these criteria, and Leslie and Happé suggest that the infant may be hard-wired to perceive such exaggerated behaviours as signs of intention or goal-directedness, in much the same way as the infant perceives physical causality in certain patterns of movement (Leslie & Keeble, 1987). Recent work by Premack and colleagues (Premack, 1990; Dasser, Ulbaek & Premack, 1989) gives some support to this suggestion. Of course, the content of ostensive displays could not be directly perceived, but would rather be inferred by central mechanisms capable of metarepresentation. Exaggeration may be one feature of ostensive displays which triggers the metarepresentational process. Understanding of pretence would emerge after understanding of ostensive behaviours like pointing, since pretend has a counterfactual content. In the absence of evidence to the contrary, a parsimonious hypothesis is that autistic people have an intact perception of intention, or triggering system, but that the metarepresentational processes are faulty, and thus cannot be switched on. It is possible, however, that even the triggering system is damaged in autism.

The power of the metarepresentational deficit theory of autism is that it has predictions which are both specific and far-reaching enough to fit the clinical picture of autism (Frith, 1989a). In particular it can explain not only the handicaps of autism, but also the preservation of some functions. It predicts that any skill which requires only primary representations should be unimpaired in autism - thus allowing for the islets of ability, good rote memory, savant abilities, and possibility for above average IQ seen in autism. Other theories have to meet this challenge. The emotional explanation of autism would seem to predict too blanket a degree of social disinterest - autistic people actually do show mental age appropriate attachment in infancy (Sigman & Ungerer, 1984; Shapiro, Sherman, Calamari & Koch, 1987), and later in life may show preferences for, and even "crushes" on,

certain people (eg. Tantam, 1991). What is striking is the lack of understanding of the two-way nature of relationships. The theory of mind explanation of autism has allowed researchers to make clear cuts in what appeared to be homogenous behaviours - cutting nature at the joints according to a precise theory about the underlying cognitive "bone structure". For example, Attwood, Frith and Hermelin (1988) found that the autistic child's well-known absence of gestures actually applied only to those gestures which normally influence mental states (eg. expressions of consolation, embarrassment, and goodwill), whereas autistic children showed as many gestures which manipulate behaviour as did mentally handicapped controls (eg. instructions to come, be quiet or go away). Similarly, Baron-Cohen (1989c) found that autistic subjects were impaired in their use and understanding of **protodeclarative** pointing but not **protoimperative** pointing. Such distinctions in the smooth continuum of everyday behaviours would appear to be hard to derive from or explain by theories of primary emotional deficits in autism. The affect-cognition debate continues (see Baron-Cohen, 1988; Hobson, 1989; Leslie & Frith, 1990; Hobson, 1990) and, although such argument is healthy, evidence that would settle the question is hard to come by. Perhaps the only kind of evidence that would satisfy both parties, would have to be gained from longitudinal case-studies, starting soon after birth.

What exactly do autistic subjects fail to represent?

Even among those who believe that lack of a theory of mind presents a good explanation of the source of the autistic child's characteristic handicaps, there is disagreement as to how best to characterise the inability to represent mental states. This issue has become intertwined with discussions of the change in normal development between 3 and 4 years old, and of what changes to allow the normal child to pass false belief tasks. Typically, paradigms first introduced to explore this point in normal children are then used with autistic subjects - although it is probable that the autistic child fails for reasons very different from the three-year-old's. So, for example, Leekam and Perner (in press) have demonstrated elegantly that the autistic child does not have a problem with representing all representations - using a "false photograph" task devised by Zaitchik (1990). Zaitchik's task

resembles the Maxi or Sally-Ann false belief tasks, except that instead of a story character's belief becoming out of date, a polaroid photograph is taken of the object at place1, placed face down on the table while the object is moved to place2, and the child is then asked; "In the photo, where is the object?". Normal three-year-old children found this task as hard as the standard false belief task - from which Zaitchik concludes that the change from 3 to 4-years involves a growing understanding of representation in general. This finding has since been replicated (Leekam & Perner, in press; Leslie & Thaiss, 1990), and shown also with line drawings (Baron-Cohen & Charman, 1990), thus dismissing doubts that the three-year-olds were hampered by a lack of experience with cameras.

Leekam and Perner (in press) found that autistic children who failed the false belief task were able to pass the photograph task, and concluded that autistic children (unlike three-year-olds) may have a specific problem with mental representations. Perner (in press) has also suggested that the autistic child's problems may be confined to misrepresentation - arguing that in the Zaitchik task the photograph does not misrepresent the current state of affairs but simply represents a past state of affairs (while in the false belief task the character's (mis)representation is of the current position of the chocolate/marble). For Perner, misrepresentation is an important concept, since it flags the fact that there is a distinction between content and referent in representation (that is, a representation represents something as something). It is interesting to speculate whether, if misrepresentation is a crucial concept missing in autistic individuals, autistic subjects would have greater difficulty understanding caricatures (relative to controls) than they do understanding photographs. Perner has developed his ideas about the nature of representation (Perner, 1991, in press) and has come to the conclusion that Leslie's (1987) decoupler mechanism does not actually produce true "metarepresentations".

Perner (1991, in press) has suggested that a fundamental misunderstanding of the word "representation" and hence of the word "metarepresentation" (in the sense first proposed by Pylyshyn, 1978), underlies Leslie's decoupler failure model of autism. He lays out clearly the three elements in a situation of representation:

Medium - Representational Relation - Content

eg. piece of paper - being a photo of - you

He then goes on to explain that if a representation is the medium eg. a photo, then a metarepresentation must not only be a "representation of a representation" (Leslie's usage) but must "represent the representational relation itself" (Pylyshyn's usage). That is, it must represent the representation as a representation. He gives a good example: A metaphoto would have to make clear that what you had photographed was *itself* a photo. So if you took a photo of the entire front page of your passport, with your photo on it, that would be a metaphoto. Taking a picture of just the photo in your passport, so that effectively you just got a picture of your face, would not be a metaphoto, but simply a photo of you produced by copying.

Perner suggests that Leslie's decoupler simply produces copies and not metarepresentations of primary representations. He goes on to argue that all the individual functions of the components of the decoupler are in fact intact in autism. Two of his main arguments here concern the "quarantining" function of the decoupler and the possibility that autistic people are unable to represent propositional attitudes. On the first point, Perner argues that representations of mental states are not peculiar in needing to be kept separate from primary representations. He claims that such quarantining must also be done for representations in different temporal contexts. Since autistic people are capable of understanding, for example, invisible displacement (Sigman & Ungerer, 1981) Perner argues that they cannot be handicapped in the ability to quarantine or put in decoupling marks certain representations. However, it is far from clear why different temporal contexts require such protection - is it really any harder for the child to keep separate the same object at two different times than it is to distinguish the same object in two different locations? This sort of task would not appear to

be of the same type as pretence - where the child must think about the object in two different and contradictory ways at the same time. Perner's argument would seem to imply that it is as great a computational challenge to represent that the cup was full and is now empty, as it is to represent that the cup is both really empty and pretend full at the same time. This seems intuitively unconvincing.

What is apparent, and Perner has clarified this, is that autistic people are quite capable of forming **multiple representations**. In Leslie's account this is captured in their preserved primary representations. But for Perner this provides a slight problem, since in his theory pretence requires only the availability of multiple representations, rather than the embedding of representations. Why then do autistic people fail to show pretence? Perner needs to show that this commonly reported feature of autism (Baron-Cohen, 1987; Wing et al 1977) is not in fact the case. He claims, based on a study by Lewis and Boucher (1988), that autistic people can, but are not motivated to, pretend. Lewis and Boucher's study found that autistic children (average age 11:10, and BPVS MA 5:9) showed as much elicited pretence as mentally handicapped and young normal controls matched on verbal ability. The study has been widely criticised (eg. Baron-Cohen, 1990), and there are obvious problems with such work in estimating where prompting becomes training. Similarly, it is hard to tell when functional play with toy miniatures becomes imaginative, pretend play. In addition, some problems are caused by the use of pragmatically sensitive measures of language ability. As we shall see in chapter 5, such a test may effectively match subjects and controls on theory of mind skills - thus giving unrepresentative samples of both groups and controlling for the interesting factor. Certainly, conservative matching techniques, using measures which autistic subjects are known to be relatively impaired on, may render trivial the unexpected lack of difference between the performance of autistic and control groups on the experimental task. In the light of the huge amount of anecdotal and experimental evidence that autistic children have an inability to pretend (Wulff, 1985), this one study needs at least to be replicated before it can be the basis for a revision of our ideas about imagination in autism.

Perner's second argument against Leslie's metarepresentation deficit theory of autism aims to prove that autistic people are not incapable of representing propositional

attitudes. In support of this claim, he quotes Baron-Cohen's (1991) finding that autistic people can accurately answer questions about their past desires, and the fact that they occasionally use mental state language in their spontaneous speech (Baron-Cohen, 1989b). The latter point does not hold much weight - Tager-Flusberg (1989) has reported very little such "cognitive" talk in autistic children, and later in this thesis (chapter 4) results will be presented which suggest that where such language is used it is commonly used quite incorrectly. However, there is a small, fairly contradictory, and yet surprisingly influential body of work which claims that autistic subjects' difficulties with mental states are in fact restricted to beliefs, and that they understand desires normally. This claim is actually made on the basis of just two studies; Baron-Cohen (1989b) and Tan and Harris (1990). Both report that autistic subjects understand that a person who gets what they want will be happy, and one who fails to get what they want will be sad. In contrast, Harris and Muncer (1988) found that autistic subjects were as poor at anticipating emotional outcome as cognitive outcome (surprise) in a very similar task. It is hard to know what to make of such results. One explanation may lie with the fact that "wants" can be computed in a number of different ways, not all of which would involve propositional attitudes.

Desire could be understood (although it may or may not be understood so by normal children) simply as a drive towards something.

eg. Mother Wants banana

Intentions (and probably the normal child's understanding of desires), on the other hand, must take the form of a metarepresentation;

eg. Mother Intends that "she eats a banana"

Desires could simply be seen as a relation between the agent and the world, without recourse to a propositional attitude. Wanting may be seen as a tropism, a tendency to act towards something in a certain way. In this case autistic subjects may understand desires but certainly will not understand intentions - the hypothesis is that in all the tasks where autistic subjects have succeeded, the character's desire

could be processed as a drive rather than a propositional attitude. This places a simple understanding of people's desires outside theory of mind. Baron-Cohen (1991) discusses something similar, in relation to his finding that autistic subjects understand situations and desires as causes of emotion, but fail to recognise that a (false) belief can make someone happy or sad. This "drive" analysis of desire would allow animals, say, to understand desire (in this sense). It is an open question, however, whether normal three-year-olds think about desire in this primitive way - and that is why it emerges first and initially dominates understanding of beliefs (Wellman & Bartsch, 1989) - or whether they have the sophisticated "intention" view of desire from early on in life (possibly as early on as pretence).

The whole of Perner's argument is too long to reproduce or address here, and in particular Perner's arguments for the correct functioning of the three elements of the decoupler in autism are open to criticisms other than those given briefly above. However, he has raised an important point about the nature of metarepresentation. Unfortunately, his brilliant criticisms are not matched by an equally satisfactory explanation for the autistic child's difficulties. Perner falls back to a relatively weak position of suggesting that autistic people do not form a theory of representations as representations because they have a "defective data base". This is in turn explained as due to an innate lack of early social orientation behaviour, which means that the autistic child has effectively less experience of the pretence and attention/information situations that Perner suggests are the important data for developing a theory of representation. This theory has not only the "chicken and egg" problems of proving priority mentioned earlier, but also the lack of specificity in its predictions for autistic behaviours mentioned in relation to emotional-deficit theories. In addition, if autistic people merely lack "data" for developing a theory of mind, one might expect other groups deprived of social experience (eg. institution-raised children) to suffer a high incidence of autism - which has not been shown to be the case. One might also expect greater individual and cross-cultural differences in the age at which understanding of false belief emerges (even in normal children), than are actually found (eg. Avis & Harris, 1991).

The Troublesome Talented Minority

Another challenge to the metarepresentation theory of autism stems directly from the data that supports the theory of mind hypothesis. It has been consistently found that a minority of autistic children in any study will pass theory of mind tasks (in Baron-Cohen et al, 1985 20% of autistic subjects passed). How can a lack of metarepresentations and hence of theory of mind explain the autistic handicap if some, equally handicapped, autistic people appear to possess a theory of mind? Two types of answers can be suggested to this problem; delay and strategy.

Baron-Cohen (1989a) has suggested that autistic people are merely grossly delayed in their acquisition of a theory of mind, and that it is therefore no surprise that a few autistic people should manage to pass these tests eventually. It has been a consistent finding that those who pass tend to be the more verbally able and older children. Frith et al (1991) found that of 42 autistic subjects tested on false belief tasks, those who passed were (with only one exception) over 11.5 years old and of a MA over 5.5 years. It must be remembered, however, that many equally advanced autistic children fail. Age and verbal ability may be necessary but they are not sufficient to ensure success on theory of mind tasks. Therefore it is not the case, as has been suggested (Eisenmajer & Prior, 1991) that failure is simply due to lack of verbal ability. The age and ability of the children tested does, however, seem to be at the root of the slightly different proportions of subjects found to pass in different studies (Frith et al, 1991).

To test the delay hypothesis, although it is unclear against quite which counter hypotheses, Baron-Cohen gave autistic subjects who did pass the Sally-Ann task a more advanced, or second-order, theory of mind test. This task, devised by Perner and Wimmer (1985), tests the child's understanding that a person may have a false belief about what another person believes. The ice cream van story they used to assess this ability is understood by normal children between the ages of 5 and 7 years. Baron-Cohen found that none of his specially selected able autistics could pass this second-order false belief task - ie. correctly predict where a story character would expect another character to go, and give a mental state justification for their answer.

However, more recently, Bowler (1989) has failed to replicate this finding. He tested subjects he diagnosed as having Asperger's syndrome - although his criteria for this were unclear, and he seems to use the label himself interchangeably with high-functioning autism. He found that these subjects were no worse than either schizophrenics or normal controls on the belief and justification questions. He found that even normal controls gave few embedded mental state term justifications, and that the autistic subjects gave no fewer. Bowler uses this finding to suggest that autistic people have a problem not with theory of mind, but with the application of knowledge in general. He suggests that autistic people may have the underlying competence but fail to use their theory of mind. Although this is an intriguing possibility, Bowler presents no real proof. His arguments are implicitly based on a static model of autism. One could take the metaphor of a car; if your car will not run and you want to know if it is because you have run out of petrol, you might look in the petrol tank - if it is full you can be sure the problem does not lie there. Many experiments on autistic children have the same philosophy. Here Bowler seems to reason that if the "theory of mind tank" is full now then the problem in autism cannot be to do with theory of mind. This is to ignore the fact that autistic children have a developmental history, and the possibility that developmental deficits may leave scars on functioning long after they have themselves been made up or smoothed over. The only way to disprove the developmental delay hypothesis for autism, then, is to find a clearly autistic child who passes all available tests of theory of mind at the normal age. No such child has yet been found.

Another way of explaining the success of a minority of autistic people on false belief tasks is to suggest that they pass these tests using a non-theory of mind strategy. In this case, the "passers'" superior IQ and age are taken as signs that they have managed to "hack out" a solution to the puzzle only thanks to experience, and using generalised problem-solving skills (Frith et al, 1991). This possibility has not been investigated experimentally, although it does make some testable predictions about the abilities of those autistic people who pass theory of mind tasks. For example, it might be expected that ability to pass theory of mind tasks would be related to some measure of general problem-solving skill in autistic but

not control groups. Recent work by Riviere and colleagues supports this idea. Riviere and Castellanos (1988) found that good theory of mind performance was highly correlated with success on a test of operational thinking in autistic subjects. No correlation was found between performance on these two tasks in normal 3- to 5-year-olds (Nunez & Riviere, 1990).

The fact that those who do pass theory of mind tests seem no less socially impaired in real life situations than those who do not, may be taken as evidence that they do not possess a theory of mind, and that their test performance is uncharacteristic of their true social understanding. This is currently being explored in a study by Frith, Siddons and Happé (in preparation) who are looking at the relation between performance on two first-order false belief tasks and real-life social skills as measured by the Vineland Adaptive Behaviour Scales (Sparrow, Balla & Cicchetti, 1984). Preliminary findings from this study suggest that groups of autistic subjects who pass or fail first-order false belief tasks do in fact differ in their everyday social behaviour. Passers are significantly better than failers on the Communication domain of the VABS, on VMA (from BPVS), and on the Play and Expressive subdomains. These results suggest a close relation between the three elements of Wing's triad - social, communication and play behaviours - and would be expected if the passers really do possess some understanding of mental states which the failers lack (see chapter 5 for more on the relation between theory of mind and communication). The two groups also show significant differences on items which were judged (a priori, by 5 researchers in the area and 15 undergraduates) to require theory of mind (comprising an "Interactive Sociability Scale"), but do not differ on items which measure general sociability not requiring understanding of mental states ("Active Sociability Scale"). So, for example, false belief passers are rated by a caregiver as significantly more likely to be able to recognise and label surprise and embarrassment than are failers, but these two groups are considered to be equally good at recognising happiness and sadness in their everyday lives. Similarly, the passers were reported to be significantly better than the failers at choosing appropriate presents, but were no more likely than the failers to be rated as showing a desire to please their caregivers. Those autistic subjects who pass theory of mind tasks are not, therefore, simply more sociable or affectionate - they are less handicapped than those who fail the tests only in areas which necessitate the

understanding of mental states. This result would appear to count against a strategy explanation of the passers' success. However, the authors stress that even this group was very severely handicapped in social skills, scoring on the VABS Social domain well below what their age and IQ would predict. They also showed more problem behaviours on the Maladaptive behaviour scale.

A third way in which a non-theory of mind strategy might be revealed is through discrepancies of functioning. The lack of "horizontal décalage" in normal development of social skills, the striking finding that theory of mind skills emerge virtually simultaneously across problems and novel situations (Gopnik & Astington, 1988; Moore, Pure & Furrow, 1990), has been taken as good evidence that normal development in this area is not based on specific scripts, which would be more or less situation-specific. It is possible, however, that autistic people use just such script/schema/prototypical knowledge to handle theory of mind tasks. In this case their apparent skills should not generalise across superficially different forms of the same test. Up to now the tendency has been to give only one or possibly two theory of mind tests and so there has been no opportunity to show the inconsistencies that might reveal a non-theory of mind strategy. In fact there has not been any work to date to check whether an autistic subject will perform consistently on the same test over time. Such studies are obviously needed to shed light on the strategy hypothesis.

As an increasing number of studies emerge in which the theory of mind deficit explanation of autism is criticised on the basis of findings that not all subjects fail such tests (Ozonoff, Pennington & Rogers, in press), it becomes vital to know what this test success actually signifies. There is an almost universal tendency to equate test performance with underlying cognitive ability, and while researchers are often keen to show that there are many reasons for failing a test, they rarely stop to consider that there may be quite as many ways of passing it. Assuming social competence from theory of mind task performance might have dangerous practical consequences: one can imagine forensic implications - theory of mind tests might be used to try to prove the cognisance and responsibility of an autistic person for a violent crime. In the provision of special education, more able autistic people

who pass theory of mind tests might therefore have their true social handicap glossed over, and be inappropriately placed in mainstream schools.

Conclusions

The area of theory of mind in normal and autistic development has grown over the last ten years into a topic far too immense to cover in one chapter of a thesis. Here I have discussed some of the issues as they pertain to autism. I have tried to show that the metarepresentation theory of autism has exceptional explanatory power and specificity. For this reason I have tried here to defend it from some of the criticisms and problems it has encountered. I have suggested that the hypothesis can withstand many of these criticisms, and that - contrary to the claims of some authors - the evidence which would make it untenable has yet to be presented.

Perhaps the greatest challenge to the metarepresentation deficit theory comes not from its critics but from the empirical work that has supported it - a challenge in the shape of those very able autistic people who **do** pass theory of mind tasks. It is this topic that I hope to address in this thesis. Beginning with a discussion of Asperger's syndrome, and a suggestion that this diagnosis should be informed by our notions of theory of mind, I will then go on to examine theory of mind abilities in a group of able subjects, with the use of a large battery of tests - and to address some of the questions raised in this chapter. From there, I will go on to look at communication in autistic people with different levels of theory of mind performance, making predictions from Relevance theory (Sperber & Wilson, 1986). Generalisation of ability across the social and communicative domains could provide strong evidence against the "strategy hypothesis". Lastly, I suggest a model which might account for the handicaps of even those autistic people who do seem to acquire a theory of mind with age and experience - and which may shed light on some of the least well understood symptoms of autism.

Chapter 2

Asperger's Syndrome

It has taken nearly fifty years for Asperger's original paper, "Die Autistischen Psychopathen im Kindesalter" (1944), to appear in translation in English (Frith, 1991). Hans Asperger deserves credit for some very striking insights into autism; some insights which Kanner (1943) lacked and which it has taken us many years of research to discover. Does Asperger deserve credit for even more than this? Does he deserve credit for recognising and describing a different disorder from Kanner's "early infantile autism"? In this chapter the description and differential diagnosis of Asperger's syndrome will be discussed, and some suggestions made for a more principled distinction between this and other disorders of development based on the "theory of mind" explanation of autism.

Asperger and Kanner; differences and similarities

The features that Asperger reports in his 1944 paper can be divided into three groups; features both he and Kanner observed, features he alone observed, and features that appear to be in direct contradiction with Kanner's report. An examination of these different symptoms, and especially of the last group of features, is a necessary starting point for the exploration of Asperger's syndrome. Are there differences in these accounts sufficient to justify Asperger's syndrome as a separate diagnosis from autism? Or can we maintain that Asperger and Kanner were describing the same sort of child, the same type of disorder?

Kanner's and Asperger's descriptions are surprisingly similar in many ways, especially when one remembers that Asperger was totally unaware of Kanner's work. Their choice of Bleuler's term "autistic" to label their patients is also a striking coincidence. This choice reflects their common belief that the child's social problems were the most important and characteristic feature of the disorder. Both

believed this social handicap to be innate (in Kanner's words) or constitutional (as Asperger put it), and to persist through life into adulthood. In addition, both Kanner and Asperger noted the children's poor eye contact, their stereotypies of word and movement, and their marked resistance to change. Both authors report the common finding of isolated special interests, often in bizarre and idiosyncratic objects or topics. Both seem to have been struck by the attractive appearance of the children they describe. They both make a point of distinguishing the disorder they describe from childhood schizophrenia, on the basis of three features: the improvement rather than deterioration in their patients, the absence of hallucinations, and the fact that these children appeared to be abnormal from their earliest years, rather than showing a falling off of ability after initially good functioning. Lastly, both Kanner and Asperger believed that they had observed similar traits - of social withdrawal or incompetence, obsessive delight in routine, and the pursuance of special interests to the exclusion of all else - in the parents of many of their patients.

In addition to the clinical insights above, which both Asperger and Kanner reported, Asperger deserves recognition for some features of autism which he alone noticed in these early years, the importance of which is now generally recognised. Asperger alone reports these children's poverty of nonverbal expression, and odd prosody. He also reports their lack of appreciation of humour except, in some cases, for puns. He describes the child's learning problems; "as if they were distracted from within" (Frith, 1991). He was also the first to note their abnormal object attachment, and often obsessive collecting of the strangest objects. These are features which have come to be recognised as typical of autism, and which Kanner remarks on also, in his later papers. However, there are some insights unique to Asperger's paper, that seem in direct conflict with Kanner's descriptions. These features in particular, then, have implications for our understanding of Asperger's syndrome.

There are three main areas on which Asperger and Kanner disagree, if we believe that they were describing the same sort of child. The first, and most striking, of these is the child's language abilities. Kanner reported that 3 of his 11 patients never spoke at all, and that the other children did not use what language they had

to communicate; "As far as the communicative functions of speech are concerned, there is no fundamental difference between the eight speaking and the three mute children". While phonology (as demonstrated in accurate echolalia) and vocabulary were often excellent, Kanner concluded that of his 11 cases, "In none...has language...served to convey meaning". The picture in all is of a child with profound communicative difficulties and delay; in 7 of the 11 cases so profound that deafness was initially suspected (but ruled out). Asperger, by contrast, reported that each of his 4 case-study patients (and, by implication, most of the unspecified number of such children he treated) spoke fluently. Although two of his patients showed some delay, this was followed in both cases by a rapid mastery of language and it is difficult to imagine any of his cases having been mistaken for deaf. All 4 cases, by the age of examination (between 6 and 9 years old), spoke "like little adults". Asperger notes their "freedom" and "originality" in language use, and reports that 2 of his 4 cases had a tendency to tell "fantastic stories".

Asperger's description also conflicts with Kanner's on the subject of motor abilities and coordination. Kanner reported clumsiness in only one case, and remarks on the dexterity of 4 of his patients. He concluded that "several of the children were somewhat clumsy in gait and gross motor performance, but all were very skilful in terms of finer muscle coordination" - in line with their success on the Seguin form board and their ability and fascination with spinning objects. Asperger, by contrast, described all 4 of his patients as clumsy, and recounted their problems not only with PE (gross coordination), but also with fine motor skills such as writing. This feature is part of a larger contrast in Asperger and Kanner's beliefs. Kanner believed the autistic child to have a specific impairment in social understanding, with better relations to objects than to people; while his children showed "excellent, purposeful and 'intelligent' relations to objects" their "relations to people [were] altogether different". Asperger, on the other hand, believed that his patients showed disturbances in both areas; "the essential abnormality in autism is a disturbance of the lively relationship with the whole environment" (Frith, 1991).

The last area of disagreement in the clinical pictures painted by Asperger and Kanner, is that of the child's learning abilities. Kanner believed that his patients were best at learning rote fashion, but Asperger felt that his patients performed

"best when the child can produce spontaneously", and suggests that they are "abstract thinkers".

How are we to understand and resolve these contradictions? One possibility would be simply to discount Asperger's insights in these three areas, and retain Kanner's opinions, which are by now "tried and tested" and found to be true of great numbers of autistic children. That we have confirmation of Kanner's clinical description should come as no surprise, after all it is his descriptions alone that have outlined what we call autism. As is becoming increasingly obvious, however, many children and adults in need of care are neglected by clinicians whose definition of autism is based on a narrow stereotype of Kanner's cases. As Wing (1988) has pointed out, the autistic person's problems may manifest themselves differently according to age and ability, meaning that there is a spectrum of behaviours that arise from similar underlying handicaps. If we hold rigidly to Kanner's descriptions we are in danger of neglecting, for example, the autistic person who no longer avoids social interaction, but instead seeks it in inappropriate ways.

If we decide, then, to retain Asperger's insights, we have to decide whether he is describing a different sort of child or the same sort of child from a different viewpoint or at a different age. On the subject of learning, for example, one might argue that both Kanner and Asperger are correct, and that the same autistic child may indeed benefit greatly from learning things rote fashion using their apparently excellent memory for unconnected facts (and given their often limited insight into the underlying principals) where teaching is involved, but be in general better at picking up knowledge when following their own interests than when being taught. It is hard, however, to reach such compromises when one turns to Asperger and Kanner's positions on language and motor skills. These areas, then, become - not surprisingly - the key issues for those who feel that Asperger was describing a different group of children from Kanner.

Diagnosis

Wing's (1981a) paper introduced the term Asperger's syndrome to English-speaking researchers. She listed six diagnostic criteria based on Asperger (1944);

- 1) Speech - no delay, but content odd, pedantic, stereotyped.
- 2) Nonverbal Communication - little facial expression, monotone voice, inappropriate gesture.
- 3) Social Interactions - not reciprocal, lack empathy.
- 4) Resistance to change - enjoy repetitive activities.
- 5) Motor Coordination - gait and posture odd, gross movements clumsy, sometimes stereotypies.
- 6) Skills and Interests - good rote memory, circumscribed special interests.

In addition to these, she reports Asperger's claim that this disorder is more frequent in males than females, and rarely recognised before the third year of life. Wing modifies these criteria, according to her own clinical experience, making three changes;

- 1) Language Delay - only half of the group Wing would label "Asperger syndrome" developed language at the normal age.
- 2) Early Development - before the age of 3 years, child may be odd, eg. no joint attention.
- 3) Creativity - Wing claims these children are not creative, and for example do not show true pretend play. Rather than being "original", their thought is simply inappropriate.

Wing used these criteria to "identify" 6 cases of Asperger's syndrome in Wing and Gould's (1979) epidemiological sample of 35,000 subjects in Camberwell.

This first paper on Asperger's syndrome set the tone for most that followed in two important ways. Firstly, it suggested that the differences between Kanner-type autism and Asperger's syndrome were to be explained by a difference in severity alone; that is, that Asperger's syndrome subjects are high ability autistics.

Secondly, it began the plethora of papers suggesting criteria for Asperger's syndrome without attention to vital issues such as which features were necessary and sufficient for this diagnosis. Wing is far less to blame on this point than many of the later writers. She openly admitted that her interest in Asperger's syndrome was a pragmatic one; as a useful diagnosis for people not fitting the strict criteria of DSM-III Autism. Such people - who may have onset post-30 months, have some degree of communicative competence, or fail to show pervasive lack of social responsiveness - should, in her opinion be recognised nonetheless as autistic. Asperger's syndrome, then, for Wing forms a means of extending the autistic spectrum to previously unrecognised, subtle degrees.

Most researchers have followed Wing's suggestions fairly closely in their diagnostic criteria for Asperger's syndrome. By the end of the eighties, something of a consensus seemed to have emerged. Kerbeshian and Burd (1986) offered five features, as well as reporting a tendency for a discrepancy between VIQ and PIQ (tantalisingly, they do not specify in which direction) in Asperger's syndrome subjects ;

- 1) Speech - pedantic, stereotyped, aprosodic.
- 2) Impaired nonverbal communication.
- 3) Social interaction - peculiar, lacks empathy.
- 4) Circumscribed interests - repetitive activities or hypertrophied skills.
- 5) Movements - clumsy or stereotyped.

Tantam (1986, 1988a,b), looking at adults with Asperger's syndrome, proposed the same core disabilities in communication, socialisation, and nonverbal expression, with conspicuous clumsiness and special interests. Gillberg (1989) required all six of his criteria for a diagnosis of Asperger's syndrome to be made. These criteria are broadly the five used by Tantam and Burd and Kerbeshian, plus a tendency for the individual to impose routine or their special interest on their entire life (recalling Wing's fourth criterion, resistance to change).

Some degree of agreement has emerged, then, on the core features of Asperger's syndrome. However, inevitably perhaps, some of Asperger's original insights have

been lost during this process. Perhaps most importantly, researchers have lost sight of Asperger's conviction that the pattern of impairments he described could occur in children of low intelligence as well as in those of high ability (see for example the proposed ICD-10 criteria, below). But there are also at least three striking features of Asperger's description which have been lost from more recent discussions of the syndrome. These features may turn out not to be specific to autism or Asperger's syndrome, and to occur in other types of mental handicap. However, it is interesting to briefly review them, especially since they will become relevant to the discussion of central coherence in chapter 7. Asperger believed all his cases (an unspecified number) to be characterised by a "disturbance of active attention". He described them as "distracted from within", and seems to mean by this that they had difficulty maintaining attention to what others directed them to, tending to follow instead their own idiosyncratic interests; "Autistic children...are...not interested in directing their attention to outside stimuli...what the school wants them to attend to. They follow their own ideas..." (p.57 in the translation by Frith, 1991). Another feature which Asperger thought characteristic of his cases was an unusual and extreme reaction to certain sensations; "In the sense of taste we find almost invariably very pronounced likes and dislikes...It is no different with the sense of touch...There is hypersensitivity, too, against noise. Yet the same children who are often distinctly hypersensitive in particular situations, in other situations may appear to be hypo-sensitive" (p.63, Frith, 1991). Extreme reactions to stimuli have been documented by other researchers (reviewed by Frith & Baron-Cohen, 1987), but have not been considered as a feature of Asperger's syndrome. Lastly, and more controversially, Asperger credits his cases with a "special clear-sightedness" (p.54, Frith, 1991). This judgement is partly discredited by Asperger's related points in praise of these children's art appreciation and perception of character. However, his comments on this subject are intriguing; "Distance from the object is the prerequisite of abstraction and of consciousness, and autistic individuals can excel in this. However, increased personal distance is also at the heart of their disturbed intuitive affective reactions...Abstractive ability, for instance, is a prerequisite for scientific endeavour...The contact disturbance which causes a helpless attitude to the matters of practical life is typical of the absent-minded 'professor'..." (p.55, Frith, 1991). Thus Asperger sees the same "distance" as underlying both the "psychopathic clarity of vision" and the child's

social difficulties. In chapter 7 a core handicap not unlike this involuntary "distance" will be discussed, which would also lead to both exceptional and deficient performance. This handicap - a failure to derive global meaning in context - may also account for the disturbances of attention and the peculiar reactions to sensations, which Asperger describes. If, as will be suggested, such a handicap persists in even those autistic people who have gained a theory of mind, these features may be of special importance for our understanding of Asperger's syndrome.

The diagnosis of Asperger's syndrome has been discussed largely by clinicians, and this may explain the loose approach to the specification of diagnostic criteria. Interest in this diagnosis began primarily in its use as a label for a type of patient who had hitherto been hard to fit into existing categories, but whom the clinician felt was an easily recognised "type". Much written on the subject of diagnosing Asperger's syndrome, then, can be seen as an attempt by such clinicians to convey an impressionistic feel of a type of patient they believe they could recognise "at first sight".

Szatmari, Bremner and Nagy (1989) have probably made the largest effort towards making the diagnosis of Asperger's syndrome look anything more than narrative. They suggested the criteria shown below in table 2.1.

Table 2.1 Szatmari, Bremner and Nagy's (1989) criteria for Asperger's syndrome

- 1) Solitary: 2 of
No close friends
Avoids others
No interest in making friends
A loner
- 2) Impaired Social Interaction: 1 of
Approaches others only to have own needs met
Clumsy social approach
One-sided responses to peers
Difficulty sensing the feelings of others
Detached from feelings of others
- 3) Impaired Nonverbal Communication: 1 of
Limited facial expression
Unable to read emotion from facial expression
Unable to give message with eyes
Does not look at others
Does not use hands to express self
Gestures large and clumsy
Comes too close to others
- 4) Odd Speech: 2 of
Abnormal inflection
Talks too much/ too little
Lack of cohesion in conversation
Idiosyncratic use of words
Repetitive pattern of speech
- 5) Does not meet DSM-III-R criterion for Autistic Disorder.

This system of diagnosis, while it deserves credit for being the most systematic currently on offer, is flawed in a number of ways common to most proposed criteria for Asperger's syndrome. For example, the lists of symptoms from which the subject must show a specified number seem to be derived without any thought to **underlying** handicaps. Describing and requiring behaviour at this surface level is insufficient; do Szatmari et al believe that a patient might show limited facial expression but be able to "give a message with the eyes"? If so, what sort of an underlying cognitive deficit could give rise to such fractionated symptoms? For this reason, the detail in their diagnostic scheme is actually a disadvantage, since it encourages us to think about surface behaviours rather than underlying deficits that

manifest themselves very differently in different individuals, different age groups, and different ability-ranges. It might be argued that the lists of alternative behaviours given by Szatmari et al are an attempt to cover just such a range of manifestations of the same underlying handicap. However, it is far from clear that the same deficit necessarily underlies a patient's "difficulty sensing feelings of others" and a patient's being "detached from the feelings of others". Similarly, not having close friends may not necessarily be attributable to the same handicap as avoidance of others. What is clear is that any diagnostic scheme for Asperger's syndrome cannot actually be free from theory: take Szatmari et al's insistence that Asperger's syndrome patients cannot meet criterion for autism in DSM-III-R. Presumably such people would be ruled out by not having language delay, by not being totally socially unresponsive, or by having onset post-30 months. Requiring that Asperger's syndrome cases not meet criterion for autistic disorder, then, means that no allowances are made for developmental change in the diagnostic picture. Wing (1981a) and others have pointed out that a child may look typically Kanner-type autistic in infancy and yet develop into a more Asperger's syndrome-like adolescent. Szatmari et al's fifth criterion denies this fact. It therefore makes a theoretical claim about Asperger's syndrome; that to have Asperger's syndrome ever you must have had Asperger's syndrome always. It also takes a theoretical stand on the distinction between Asperger's syndrome and autism.

It needs to be recognised, then, that diagnosis is not theory-free, even when it pretends to be so. If this is the case we need to think carefully about diagnosis and theory and how they interact. It is a major problem with most studies of Asperger's syndrome that we cannot be sure to what extent the same sort of population of "Asperger's syndrome" subjects has been used. We need strict diagnosis for experimental purity of sample, but our diagnosis presupposes our findings since to choose our criteria we look to our beliefs about the disorder. Perhaps what is needed is a more preliminary exploration. One approach might be simply to look for real subgroups in the autistic population (see later, p.74). Another approach would be to examine the clinical judgements made; compare those diagnosed Asperger's syndrome by different clinicians on a number of measures. A third answer is simply to recognise the theoretical biases that drive diagnosis, and then use them more explicitly. A set of criteria for Asperger's syndrome derived

openly from theory could be used to define a subject population, which could then be contrasted with some other group on a number of tasks and measures of real-life adaptation.

Sadly, none of these approaches has been used in the drafting of the provisional ICD-10 (World Health Organization, 1990). The criteria for Asperger's syndrome in ICD-10 can be seen in table 2.2. As can be seen, Asperger's syndrome seems to be defined as autism without the language and cognitive impairments. Note that this carries the theoretical implication that the language and cognitive impairments in autism are not fundamental to the disorder, and do not arise from the same cognitive deficit as the social difficulties. The implication is that the language and cognitive impairments are additional handicaps, which can be present with or without autism, and leave the picture of "core" (ie. social?) handicaps unchanged in their absence. Asperger's syndrome in this document is said to include "at least some cases" which "represent mild varieties of autism". The unspoken message here is that mild autism equals mild retardation and mild language difficulties. However, it might be argued that mild autism means a mild degree of social handicap. If so, then IQ should not be a criterion (as it is; "...a lack of any clinically significant general delay in...cognitive development"), until it is proved that it is impossible to be relatively able socially but less able intellectually if you are autistic. This may well be the case, but it is a question a researcher would not be allowed to gloss over in a paper, and neither should it be taken for granted in ICD-10.

Table 2.2 Criteria for Asperger's syndrome in the draft of ICD-10

- A. A lack of any clinically significant general delay in language or cognitive development. Diagnosis requires that single words should have developed by two years of age or earlier and that communicative phrases be used by three years of age or earlier. Self-help skills, adaptive behaviour and curiosity about the environment during the first three years should be at a level consistent with normal intellectual development. However, motor milestones may be somewhat delayed and motor clumsiness is usual (although not a necessary diagnostic feature). Isolated special skills, often related to abnormal preoccupations, are common, but are not required for diagnosis.
- B. Qualitative impairments in reciprocal social interaction (criteria as for autism).
- C. Restricted, repetitive, and stereotyped patterns of behaviour, interests and activities (criteria as for autism; however it would be less usual for these to include either motor mannerisms or preoccupations with part-objects or non-functional elements of play materials).
- D. The disorder is not attributable to the other varieties of pervasive developmental disorder; schizotypal disorder; simple schizophrenia; reactive and disinhibited attachment disorder of childhood; obsessional personality disorder; obsessive-compulsive disorder.

In ICD-10, autism is diagnosed if the patient meets a certain number of criteria out of a list of possible behaviours. This leads to problems of differential diagnosis when we consider Asperger's syndrome. Why is Asperger's syndrome needed when there is a category of "Atypical Autism", which allows a child to fail to fit all criteria for autism (so the child might show symptoms late, might have some social skills, or relatively normal language ability)? In any case (by the argument given above), most Asperger's syndrome people would probably fit the ICD-10 autism diagnosis itself. For example, in Communication, a person needs only 2 out of the 5 impairments listed, to be classed autistic. Of these five, one would expect most Asperger's syndrome people to show at least the following three items;

- 2) Relative failure to initiate/sustain conversation,
- 3) Abnormality of prosody,
- 4) Lack of varied spontaneous make-believe play.

Similarly, the person with Asperger's syndrome could fit the required 3 out of 5 symptoms of social impairment, and so on. The only strong distinctions in the diagnosis of Asperger's syndrome seem to be age of onset and lack of language delay. Both of these are dubious, because they depend in general on indirect report, and because they do not allow for developmental dynamics. The criteria for language development, in particular, are both too specific and too vague in an area about which we know so little: "Diagnosis requires that single words should have developed by 2 years of age or earlier and that communicative phrases be used by 3 years of age or earlier". This diagnostic requirement is not based on any recognised theory of normal language acquisition, and is not precise - it is not clear what is to be considered a word, how many must be acquired, or what should be considered a communicative phrase. The implication of this criterion is, once again, that the failure of most autistic children to develop language normally is quite separate from their failure in social development. I hope that chapter 5 will go some way towards showing how wrong this presumption may be.

ICD-10, then, as it stands, excludes from the diagnosis of Asperger's syndrome cases where an autistic childhood gives way to an Asperger's syndrome adulthood. There is not as yet any proof to back such a decision; one would need to show that such adults are very different from those who have had an Asperger's syndrome childhood. However, if diagnosis "jumps the gun" in this way, such important questions will never be answered, because the populations used for research will be selected according to prejudicial criteria.

Differential Diagnosis of Asperger's syndrome

Those who deny the need for the label Asperger's syndrome, on the grounds that autism serves the purpose, (eg. Volkmar, Paul & Cohen, 1985) might do well to look beyond autism. They would find a staggering and unsystematic array of proposed syndromes and diagnoses for children with some degree of social or communication disability, who do not fit existing categories of diagnosis. Do these children have Asperger's syndrome? The question cannot be answered without proper experimentation. The fact that the Asperger's syndrome subjects in many

studies (eg. Szatmari, Bremner and Nagy,1989) are reported never to have received a diagnosis of autism, but rather to have been labelled with a variety of diagnoses from "hyperactive" to "schizophrenic", sometimes applied to the same child by different clinicians, suggests that they form a problematic group for diagnosis. An examination of some related disorders highlights the need for a more principled differentiation of diagnoses, and may shed some light on the place of Asperger's syndrome in developmental disorders.

Semantic-Pragmatic Disorder

Semantic-pragmatic disorder (a term coined by Rapin & Allen, 1983) became a popular diagnosis among speech therapists in the mid eighties. In 1984 and 1985 letters and reports appeared in the College of Speech Therapists Bulletin, describing groups of children with severe language problems of a type hard to classify in terms of existing diagnoses. Allan and Hastings (1984) reported ten children with comprehension problems, echolalia, verbal conceptual deficits, and an inability to use gestures. In addition these children showed severe early behaviour problems and a poverty of symbolic play, although their VIQ exceeded their PIQ, and they often read beyond their comprehension. Haynes (1985) described the same characteristics, and said that such children have a "poor awareness of what knowledge is, and is not, shared by speaker and hearer".

Despite obvious similarities, Haynes insisted that at least some of these children were not autistic. However, it is not clear to what extent this judgement is based on her claim that these children are not withdrawn, and are affectionate. This suggests that too narrow a conception of autism, or too strong an adherence to a Kanner-type stereotype, may have led these authors to discard a diagnosis of autism prematurely. The fact that they report the children to be egocentric, with poor social skills, so that they are incapable of getting on with their peers, showing affection only to adults, suggests a picture reminiscent of Asperger's original cases. Nothing in the exploration of these children by Bishop and Adams (1989) (and Adams & Bishop, 1989) contradicts such an idea. The fact that the validity of the semantic-pragmatic disorder diagnosis separate from autism is still strongly maintained by these authors is understandable, but the distinction from Asperger's syndrome is less clear. The claim is made that not all children with semantic-

pragmatic disorder show social impairment. This may be due to a narrow definition of social impairment (eg.in the aloof but not the active but odd child). It is hard to imagine (as is implied) that pragmatic skills alone could be deficient; pragmatics is unlikely to form a "module", and is more easily envisaged as reliant on central processes, and in particular on the ability to understand other minds which appears to underlie normal social behaviour.

In a recent article discussing the boundaries between autism, Asperger's syndrome and semantic-pragmatic disorder, Bishop (1989) suggests that a continuum approach should be taken in this area. She suggests not just a single continuum of severity, but two dimensions, in order to capture the differences in **pattern** of symptoms between the disorders. This is an advance on other approaches, and Bishop shows great sensitivity to the issue of the diverse manifestations of social handicap. However, her model of two dimensions again presumes theoretical points not yet established. Autism, Asperger's syndrome and semantic-pragmatic disorder can, for her, be represented as different but overlapping areas on a graph where the x-axis is "meaningful verbal communication", and the y-axis represents "interests and social relations" (both ranging from "abnormal" to "normal"). However, this presupposes that there is no necessary relation between social and communicative competence - since such a graph would be pointless if all subjects with mild social deficits necessarily had mild communicative deficits and so on. In chapter 5 I will argue for precisely such a necessary connection between social and communicative competence. Indeed, Bishop herself refers to findings by Rutter (1978) that support such a connection: he found that among "dysphasic" children the more autistic-like an individual's language problems were, the more autistic-like were the social problems they showed. Of course a necessary connection only holds between social skills and **communication**, not language ability - specific language handicaps are possible with or without social problems. The fact that Bishop labels her axis "meaningful verbal communication" (my emphasis) suggests rather that she may have in mind something more akin to a language handicap; problems with pragmatics alone should be manifested equally in all channels of communication (gesture, facial expression, eye contact).

Right Hemisphere Learning Disabilities

The literature on developmental right hemisphere problems has recently been reviewed by Semrud-Clikeman and Hynd (1990), who document a vast array of supposedly distinct syndromes that involve social, motor and visuospatial deficits. The connection of these deficits with the right hemisphere is made largely by analogy with adult brain insult cases. Extrapolating from the behaviour of an adult who has incurred damage to a fully developed cognitive system, to that of a child whose capacities have developed in the absence of a particular cognitive component, is a road replete with pit-falls. However, the array of symptoms shown by so-called right hemisphere learning disabled children is still of interest in its own right, whatever the site of damage.

Weintraub and Mesulam (1983) presented 14 children with social and visuo-spatial problems, and neurological "soft signs" of right hemisphere damage. The four case histories given are certainly reminiscent of Asperger's cases. Of the 14 children, all showed gaze avoidance, 11 used little or no gesture, 12 had flat prosody, and 13 were described as "shy". The authors conclude: "There is a syndrome of early right hemisphere dysfunction that may be genetically determined and that is associated with introversion, poor social perception, chronic emotional difficulties, inability to display affect, and impairment in visuospatial representation".

Not surprisingly, it was not long before researchers pointed out the similarity between this picture and the clumsiness, odd speech and poor social interaction of Asperger's syndrome patients (DeLeon, Munoz and Pico, 1986; Denckla, 1983). Certainly Voeller's (1986) description of one little boy with right hemisphere deficits, travelling in a car with his class mates, sounds very like one of Asperger's cases; "they were all talking about ball games, and he was talking about the way train signals worked".

A similar sort of child seems to have been recognised in an earlier paper by Johnson and Myklebust (1971) on "nonverbal learning disability". They describe such children as unable to comprehend the significant aspects of their environment, lacking the ability to pretend or anticipate, and showing problems with gesture and facial expression. Why did these authors, who recognised that their patients had

a "social perception" disability, not simply diagnose them as autistic? The answer probably lies in part in the narrow conception of autism still held by many clinicians. The argument has been made that we should be making diagnostic categories progressively narrower, to clarify research findings and make equivalent the results from different studies. However, it seems true to say that different manifestations of the same underlying handicap should be grouped together. That is, we would not change a person's diagnosis just because he was older, or no longer quite so impaired. The question is, then, what is a matter of degree, and what is really a qualitatively different disorder?

Again, theory must guide these decisions. For example, if a theory of autism posits that the fundamental and defining handicap leads to communication, socialization, and imagination impairments, then a child who shows flexible and creative make-believe play cannot be said to be autistic. On the other hand, a child who shows subtle (but characteristic) pragmatic impairments, rather than the more typical gross deficits, could still be diagnosed autistic - without stretching the diagnostic boundaries past usefulness. As Wing and Gould (1979) have shown, an autistic person may demonstrate their social incompetence just as much in an active but odd attempt to make friends as in avoiding all human contact. Nevertheless, it is possible that these different behaviours might have been caused by quite different underlying defects - eg. in the first case social incompetence, in the second dislike of people. The reason that this possibility can be ruled out is that the same autistic person may manifest both sorts of peculiarity, either over a span of a few years, or to different people at the same time.

Can a "theory of mind" approach to autism clarify diagnosis in this very murky area of mild disorders? The answer is yes, in some cases at least. Take, for example, the "Atypical" children described by Sparrow, Rescorla, Provence, Condon, Goudreau and Cichetti (1986). The authors conclude that these children are not autistic because they are of a high cognitive level. They say that they are not just able autistics because they do not have such severe social-communicative problems. This is a case of degree, and quantitative difference. Theory of mind explanations of autism would lead one to say that people who show the same sort of social problems as more severe autistics, but to a milder degree, are autistic if they also

show the characteristic communication and imagination impairments. The vital question is whether the deficits are of the same sort - that is, are they caused by a lack of understanding of mental states as the independent contents of other minds? Another example may clarify further: Robinson and Vitale (1954) discuss children with circumscribed interest patterns. These children sound very like mildly autistic cases - and indeed Burd and Kerbeshian (1987) conclude that these are Asperger's syndrome children. However, the description of the children's social problems makes some mention of their unimpaired ability to pretend; one of the three cases they describe, John, played cowboys appropriately at the age of 9, and one occasion is mentioned when he pretended a badge was a microphone. Robinson and Vitale also recount how those children who show compulsive acts will only do so in front of familiar people, and how - although unpopular - one boy (Tom, aged 13) could handle himself well in repartee with his peers. If these observations were backed up by experimental evidence, then they would shed doubt on the idea that these children's social problems stem from the same cause as autistic children's handicaps (hypothesised to be a deficit in theory of mind).

An interesting possibility exists, however, that some of the children considered to have right hemisphere learning disabilities may have a specific impairment in representing representations outside the social domain. That is, these children may have a deficit in the formation of second order representations extending beyond the representation of mental states. If this is the case, then they would be expected to fail not only theory of mind tasks, but also Zaitchik's (1990) photograph task (in contrast to autistic children who generally fail false belief but pass false photo tasks; Leekam & Perner, in press; Leslie & Thaiss, in press - cf. p.34/35). An inability to understand representations as representations, in all domains (or even perhaps in all but the mental domain?) might lead to the sorts of visuo-spatial difficulties that are described in this (highly heterogeneous) population. Alternatively, those children who have normal theory of mind may have an impairment in processing the global, context-dependent meaning of stimuli. Such a deficit will be discussed in chapter 7.

Anecdotal reports can never be conclusive. What does "poor communication" mean? What are "social problems"? Even examples given to clarify such general terms

cannot always be interpreted out of context. Here again, theory of mind approaches help, by allowing an experimental test of social understanding one level down from surface behaviours - which are themselves so affected by teaching, compensation, and rote repetition in familiar situations. The potential usefulness of such tests may become clear as we look next at Asperger's syndrome's greatest competitor.

Childhood Schizophrenia and Schizoid Personality Disorder

The term "autistic" was first used by Bleuler (1908) to describe the social withdrawal seen in schizophrenic patients. Perhaps it is not surprising, then, that for a long time autism was believed to have strong links with schizophrenia, and indeed up to the late 60's was used interchangeably with a diagnosis of childhood schizophrenia (see Rutter, 1978a for a review of this confusion). Since then, autism has been shown **not** to be connected with schizophrenia in any straight-forward way (Kay & Kolvin, 1987). Certainly, it is not the case that autistic people are more likely to become schizophrenic, nor is schizophrenia particularly prevalent among the relations of autistic people.

However, links between research into schizophrenia and into autism still exist. Frith and Frith (1991) have pointed out the similarities between the negative symptoms of schizophrenia, and the handicaps seen in autism. They suggest that a similar cognitive deficit - specifically in theory of mind - might underlie both disorders. The great differences in appearance of the two disorders would be expected; breakdown of a mature cognitive system will not have the same effects as the lack of a cognitive component from the start of development.

A second link between schizophrenia and autism has come about through Asperger's syndrome. Sula Wolff and her colleagues have studied a group of children with what they call "schizoid personality disorder", who are oversensitive, emotionally detached, solitary, rigid/obsessive, lacking in empathy, and prone to odd ideation. They claim that these are the sort of children Asperger was describing in his 1944 paper. Wolff argues, therefore, that Asperger's syndrome does not belong within the autistic spectrum, but rather is part of a group of schizotypal or schizoid disorders.

Wolff's initial description of schizoid personality disorder (Wolff & Chess, 1964) did not refer to Asperger's paper. However, she was careful to distinguish her group from autistic children on the basis of three features. She claimed that the schizoid children - unlike those with autism - did not show any of the following; late/poor language acquisition with echolalia; a lack of emotional responsiveness and gaze avoidance; and ritualistic behaviour. It is not clear, however, precisely how her group could fit her criteria for schizoid personality disorder without any of the above problems. Her criteria include "emotional detachment" and "rigidity, sometimes to the point of obsession", and she describes the children as using odd "metaphorical" language. As before, the terms are too vague to allow a principled distinction to be made. The difference between the groups, then, appears to revolve around severity and age of onset - two factors which are intimately connected (since milder impairments take longer to reach parents' attention), and which provide no evidence of qualitative rather than quantitative differences.

Wolff and Barlow (1979) made a more systematic, experimental comparison of schizoid and autistic children. They tested 8 pairs of children, matched on age, sex and nonverbal IQ, on linguistic, auditory recall, perseveration, affect, and motor tasks. They claimed that the following differences distinguished the schizoid and autistic groups;

- the schizoid children appeared less "motivated", and more "distracted from within" than the autistic subjects. The authors claim this accounts for the poorer performance on tasks such as digit span.
- the schizoid children showed better language.
- the schizoid children showed less perseveration than the autistics.
- the schizoid children used fewer emotional or psychological constructions in a "describe your mother" task (it is worth noting, however, that the autistic group used more such terms than even the normal controls).

One methodological problem with this study is that the groups were not "typical", according to the authors, due to the constraints of IQ-matching. Hence the schizoid subjects were less able than most such children and the autistics more able than is

usual for this group. It is hard, then, to know what to make of these relatively slight differences. Could the "schizoid" group be composed of very able autistics, who are different only in having higher verbal IQ and being less "avoidant" than the more typical "autistic" group? Certainly, it is hard to see anything in the diagnostic criteria which Wolff and Cull (1986) propose for the disorder, which could in principle distinguish schizoid personality disorder from autism (at the higher ability end of the spectrum). They list six core features of schizoid personality disorder, as follows;

- 1) Solitariness
- 2) Impaired empathy and emotional detachment
- 3) Increased sensitivity, amounting to paranoia
- 4) Unusual styles of communication
- 5) Rigidity of mental set, eg. single-minded pursuit of special interests.

Only "increased sensitivity" would look out of place in a description of an able autistic child. Wolff and Cull claim that Asperger's syndrome is a severe form of schizoid personality disorder, the latter being a broader category covering cases not fitting Asperger's syndrome, and overlapping with ICD-9's "schizoid paranoid personality disorder". An important question, then, is how are the schizoid personality disorder children who **do not** have Asperger's syndrome different from those who **do**? This is not made clear, and the implication is once again that the difference is in severity.

There may be good reason, however, to distinguish Wolff's schizoid children from children with autism. As before, a theoretical stance is necessary to pass beyond the level of behaviour, at which level many different disorders look the same (think of elective mutism, deafness, extreme shyness, and developmental aphasia). If we take the hypothesis that autism involves a fundamental deficit in theory of mind, how does this affect the boundaries between autism and schizoid personality disorder? We can look for evidence that theory of mind might be normal (or even "over-active") in Wolff's schizoid children. This is hard to judge without specific investigation, easy to test experimentally. In the absence of test results, there is some indication from the descriptions and case histories that schizoid children may

show social isolation and detachment for quite different reasons from autistic children. Think again about the "increased sensitivity, amounting sometimes to paranoia". This sounds implausible from a child who has no insight into other minds, let alone into what those minds might be thinking about him or her. Similarly, in Wolff and Cull's discussion of antisocial behaviour in schizoid children, they suggest that this behaviour has less to do with family disruption or social disadvantage, and more to do with these children's unusual fantasy lives. Typically, the authors say, the boys show hostility and the girls show pathological lying. The authors quote the description of one schizoid girl by her clinician; "Her intuitiveness and presence of mind seem to have been bordering on the miraculous". Clearly, a rich fantasy life, pathological lying, and intuitiveness would seem to contra-indicate autism. Although such descriptions can be misleading, these features do suggest that a principled distinction between autism and schizoid personality might be possible on the basis of theory of mind ability.

The question remains, however, does Asperger's syndrome belong with schizoid personality disorder or with autism? To decide this we need to look at the implications of both possibilities. Although schizoid personality disorder is seen by Wolff as a personality variant rather than a pathology (a view interestingly similar to Asperger's own concerning his cases), the diagnosis suggests connections with schizophrenia; a predisposition, familial loading, or a milder but characteristically similar disorder. Studies of "schizophrenic children" (a group that almost certainly includes some schizoid personality disorder children, since hallucinations and delusions are not usually necessary for the diagnosis of schizophrenia in childhood) show features that do not fit the Asperger's syndrome picture, and are different not only in severity. For example, Van Lancker, Cornelius and Kreiman (1989) found that autistic but not schizophrenic children showed impaired recognition of the emotional-prosodic meaning of speech - a deficit we would expect in Asperger's syndrome (Scott, 1985; Tantam, 1986). Asarnow, Tanguay, Bott and Freeman (1987) found that schizophrenic children showed a very different profile across the subtests of the WISC-R, seeming to be worse than autistics on "factor 3" (said to test freedom from distraction with the coding, arithmetic, and digit span subtests). Autistic children were worse than schizophrenics on the comprehension subtest - a

feature we would expect in Asperger's syndrome also, given the reports of Asperger's syndrome people's lack of "common-sense".

A study by Green et al (1984) gives some insight into why some clinicians might feel that Asperger's syndrome is better seen as part of a schizoid spectrum rather than an autism continuum. These authors found that their autistic sample differed from their schizophrenic sample in age of onset (schizophrenics post 5 years), IQ (schizophrenics cleverer), and behavioural symptom profile. On this last point, the authors claim that the autistic profile included gaze avoidance, withdrawal, stereotypies, and echolalia - while the schizophrenics showed blunting of affect, incongruous affect, hallucinations, and disordered thought content. It is clear why someone who thought that autism presented a static picture characterised by withdrawal or gross language impairment would fail to recognise the relation of this disorder to Asperger's syndrome. But what about those researchers with a less narrow view of autism?

Nagy and Szatmari (1986) claim that Asperger's, Wing's and Wolff's descriptions all refer to the same population of children, which corresponds to DSM-III "schizoid personality disorder". However, this diagnosis includes ideas of reference and abnormal perceptual experiences as features, and does not mention problems with nonverbal expression - a feature which some researchers (eg. Tantam, 1986) believe to be of primary importance in Asperger's syndrome. Such a diagnosis underestimates the importance of Asperger's syndrome people's odd speech, special interests and deficits in nonverbal communication. As such, it is unlikely to aid in the provision of the right schooling and care for this group. As Wing (1984) says, while making links between Asperger's syndrome and autism has useful implications for management, a diagnosis of schizoid personality disorder "is distressing without being constructive". She also makes the important point that the latter diagnosis is as yet vague and while it may include some people with Asperger's syndrome it also includes many with quite different disorders.

Other researchers have also argued against making connections between Asperger's syndrome and schizophrenic disorders. Tantam (1986) in his study of lifelong eccentricity, concluded that his Asperger's syndrome adults could be differentiated

from those who were schizoid. He suggests that Asperger's syndrome, and particularly the characteristic deficit in nonverbal expression, may be a risk factor for developing such disorders: while odd nonverbal expression was rare without schizoid personality disorder in his group, schizoid personality disorder was often found without problems in nonverbal expression. Kay and Kolvin (1987) conclude that schizophrenia in childhood is essentially the same syndrome as in adulthood, and that autism is not directly related to either. They say that Asperger's syndrome should be seen as a mild variant of autism, Asperger's syndrome being a personality disorder rather than a psychosis.

There do seem to be good reasons to connect Asperger's syndrome and autism in some way. A growing number of family studies have found the co-occurrence of Asperger's syndrome and autism in the same family to be higher than expected by chance. Bowman (1988) reports a family in which the four sons and the father all show differing degrees of autistic handicap - from the mildest case, which looks like Asperger's syndrome, to the most severe, a typical "Kanner case" where autism is compounded by mental retardation. Similarly, Burgoine and Wing (1983) report a set of triplets who span the range from Asperger's syndrome to classic Kanner-type autism. Eisenberg (1957) gives a description of some of the fathers of autistic children, which is highly reminiscent of accounts of Asperger's syndrome adults - and recalls Asperger's conviction that the parents of his patients showed similar traits to their Asperger's syndrome children. Most recently, Gillberg (1991) has described the families of 6 Asperger's syndrome individuals between the ages of 6 and 33. He found that Asperger's syndrome or Asperger-like traits could be found in at least one first or second-degree relative of each of the children. Across the 6 families he found that 3 of the mothers, 4 of the fathers, 1 brother and 1 paternal grandfather were affected. In addition, 2 of the families had a first-degree relative afflicted with autism.

Asperger's Syndrome and Autism; How different is different enough?

Establishing that there is a connection between autism and Asperger's syndrome, and that Asperger's syndrome is more akin to disorders on the autistic spectrum than to those in the schizophrenic-schizoid group, leaves us with still more questions of differential diagnosis. First, is Asperger's syndrome a distinct (if related) disorder from autism? If "yes", what is the distinction, and does it warrant recognition - does it have implications for management, education and prognosis? If "no", is Asperger's syndrome simply a label for all autistic people with relatively high IQ, or should it apply to a specific subset of the "more able" autistics? In this section these questions will be addressed, and the claim made once more that theoretical models of autism must inform such decisions.

Asperger, by 1979, felt sure that the children he described were in a separate category from Kanner's children with "early infantile autism", although he recognised that the two groups had much in common. He put forward as distinguishing characteristics the fact that his patients had good logical and "abstract" thought, good surface language, and a better prognosis than Kanner's subjects. These three features might be explained by higher IQ alone, but Asperger insisted that the syndrome he described could occur at all IQ levels, from the "genius" to the "automata-like mentally retarded" (Asperger, 1944 in Frith, 1991). For example, Hellmuth (described by Asperger in his original 1944 paper) showed the characteristic features of "autistic psychopathy", despite brain damage and retardation.

Van Krevelen (1971) follows Asperger in making a strong bid for the independence of Asperger's syndrome. According to him, "autistic psychopathy" and Kanner's autism are "two entirely different nosological syndromes" - though he does admit there are connections, such as the familial co-occurrence. The crucial difference, in Van Krevelen's view, is the child's attitude to others; autistic children act as if others did not exist, while Asperger's syndrome people evade other people, of whom they are aware. It is interesting to note that Van Krevelen's description stresses much more than does Asperger's the child's visuo-spatial problems (for

example in judging distances), maths inability and clumsiness - giving a picture strikingly reminiscent of the "right-hemisphere learning disabilities" discussed above. The full table of differences that Van Krevelen proposes can be seen in table 2.3. He concludes that autism occurs where there is the genetic predisposition for Asperger's syndrome plus the occurrence of brain damage.

Table 2.3 Van Krevelen's distinguishing features of Asperger's syndrome

<u>Early Infantile Autism</u>	<u>Autistic Psychopathy</u>
1. Manifestation age: first month of life.	Manifestation age: third year or later.
2. Child walks earlier than he speaks; speech is retarded or absent.	Child walks late, speaks earlier.
3. Language does not attain the function of communication.	Language aims at communication but remains "one-way traffic".
4. Eye contact: other people do not exist.	Eye contact: other people are evaded.
5. The child lives in a world of his own	The child lives in our world in his own way.
6. Social prognosis is poor.	Social prognosis is rather good.
7. A psychotic process.	A personality trait.

Kanner is not known to have expressed an opinion on Asperger's syndrome, or its relation to autism as he defined it. However, Burd and Kerbeshian (1987) quote Kanner's commentary on the Robinson and Vitale report of children with circumscribed interest patterns, in which he says that these children do not fit his definition of autism. Burd and Kerbeshian claim that these children do fit the description of Asperger's syndrome, but there is some question whether they are really the same sort of children (cf. p.61).

More recently, Szatmari, Bartolucci, Finlayson and Krames (1986) have presented a case study to support the claim that "not all children with Asperger's syndrome are autistic, at least as judged by early history and prognosis". However, the

question again arises of how narrow a definition of autism is appropriate. Their subject, Mary, had no language delay, but otherwise sounds fairly typically autistic. The authors claim that Mary's outcome - she developed auditory hallucinations during adolescence - makes it unlikely that she was autistic. This is something of a presumption. Certainly, there have been reports in the literature of patients who perfectly fulfil the criteria for autism in childhood, but who go on to develop schizophrenia later in life (Petty, Ornitz, Michelman & Zimmerman, 1984; Watkin, Tanguay & Asarnow, 1988).

Experimental studies have failed to reveal any very striking differences between groups of autistic and groups of "Asperger's syndrome" children. This is due in part, no doubt, to the problem of diagnosis. It would not be an exaggeration to say that no study to date had satisfactorily defined and distinguished populations of Asperger's syndrome and of "non-Asperger's syndrome" autistic children. This, in its turn, is not surprising. There is not only the problem of a lack of agreed diagnostic criteria, there is also the more insidious problem of defining groups on the basis of fractionated surface behaviours alone, with no thought to underlying deficits and their necessary and sufficient manifestations at the symptom level.

Szatmari, Tuff, Finlayson and Bartolucci (1990) compared "high-functioning" autistics (HFA), Asperger's syndrome patients and an outpatient control group on a number of tasks. The diagnostic criteria for Asperger's syndrome were isolated behaviour, odd speech/nonverbal communication/preoccupations, impaired social relations, and onset before age 6. It is not clear in what way the HFA group did not conform to this description. Sadly, IQ-matching of the experimental groups in this study led to a significant difference in age; the HFA children being significantly older than the Asperger's syndrome group. In addition, the controls were significantly brighter than the experimental groups. Few major differences emerged between the Asperger's syndrome and HFA groups, although both were very different from the controls. The majority of the differences that reached significance were found in the answers mothers gave about their child's history - which is problematic since it seems plausible that a better outcome may lead parents to remember the former years in a more positive light. Szatmari et al found that more mothers of HFA than of Asperger's syndrome children reported their

child to lack social responsiveness to them, to have a complete lack of interest in social relations, to show echolalia, repetitive speech and stereotypies, and to show no imaginative play. More Asperger's syndrome than HFA children showed affection as a baby, shared their special interest with their parents, and enjoyed the company of adults other than their parents - according to the mothers' report. Interestingly, no major difference emerged on pegboard tests for motor skills. A lack of any striking difference was also found in a study of early history and outcome with these subject groups (Szatmari, Bartolucci and Bremner, 1989). Echolalia, pronoun reversal, global social impairment and restricted activity were more common in HFA children. Perhaps the only finding of note, and not easily explained by a failure to match subject groups on VIQ, was that the Asperger's syndrome group were more likely to develop a secondary psychiatric disorder than were the HFA patients. Szatmari et al conclude that "there were no substantive, qualitative differences between the Asperger's syndrome and autistic groups, indicating that Asperger's syndrome should be considered a mild form of high functioning autism".

Ozonoff et al (in press), by contrast, in a study of differences between an Asperger's syndrome group and a HFA group, concluded that an empirical distinction could be made. Their subjects were matched on CA, PIQ and full scale IQ, but differed significantly on VIQ (Asperger's syndrome subjects exceeding HFA subjects). Ozonoff and her colleagues found that both groups were impaired relative to controls on executive function tasks and emotion perception, but that only the HFA group showed significant impairments on theory of mind tasks and memory tasks. The authors conclude from this that HFA and Asperger's syndrome are empirically distinguishable on measures independent of diagnostic criteria, and that theory of mind impairment cannot be the primary handicap in autism (since it is not pervasive throughout the continuum to Asperger's syndrome). Instead, they claim that there are unifying deficits in autistic and Asperger's syndrome subjects which point to frontal lobe damage. However, there are some flaws in this study that cast doubt on these otherwise unusually clear findings. The major problem with the study is the diagnosis of Asperger's syndrome here; this is made on the basis of current symptoms only, and yet Ozonoff et al claim to have used ICD-10 criteria for diagnosis. It is hard to see how ICD-10 could be applied with any rigour

without information on history and especially language development in these subjects (given ICD-10's strict criteria of no language delays). In fact, the authors report that half of their Asperger's syndrome subjects had typical autistic language symptoms and developmental delays. Evidently, if we cannot be sure of the diagnosis in this study the findings - although interesting in themselves and useful perhaps in the search for subtypes - cannot as yet tell us whether Asperger's syndrome is a distinct subtype of autism.

Accepting Szatmari et al's conclusion (that Asperger's syndrome is just a mild form of autism), however, does not solve the puzzle of Asperger's syndrome. What does it really mean to say that Asperger's syndrome is a "mild form of high functioning autism"? Is Asperger's syndrome a mild form of high functioning autism, or the mild form of high functioning autism? What must be decided, in other words, is whether there are other "mild forms of high functioning autism" which are not Asperger's syndrome.

Most researchers have come to much the same conclusion as Szatmari and his colleagues, and are content to explain the differences between Asperger's syndrome and autism on the basis of severity. This explanation implicitly suggests that there could not be other types of able autistic person. If Asperger's syndrome people are different from other, more Kanner-type autistics only because of a "milder" handicap, then **any** autistic person with such a mild handicap will be (by definition) Asperger's syndrome. This is implicit in Wing's (1981a) conclusion that there is no distinction between Asperger's syndrome and higher level autism, being just part of the autistic continuum. At the same time she argues that Asperger's syndrome is useful practically, as a label for **less typical** autistic people, who do not fit the pattern of the child who is "agile, but aloof and indifferent to others, with little or no speech and no eye contact". One might take the stance that this very "atypicality" - in more than just IQ - suggests there might be subgroups of "mild autism", but Wing feels that all the differences are explained by severity and ability level.

A number of authors take the same stand as Wing. Schopler (1985) not only claimed that there were no behavioural distinctions between Asperger's syndrome

and high level autism, but went further in denying even the usefulness of the term. Volkmar et al (1985), express the same view. Other researchers have claimed that Asperger's syndrome is a distinguishable group even if just the group at the upper end of the ability (or the lower end of the severity) spectrum. Gillberg (1989) compared 23 Swedish children with Asperger's syndrome against 23 autistic children, matched for IQ and age (range 5-18 years). As previously, it is not clear in what respects the autistic children did not fit Gillberg's criteria for Asperger's syndrome. This lack of explicitness is very unfortunate, since any findings in the comparison might have been implicit in the definition used for diagnosis. Gillberg finds the following differences. The frequency of Asperger's syndrome-like problems in the parents was higher for the Asperger's syndrome children (57% versus 13%). Motor clumsiness was more common in the Asperger's syndrome children (83% versus 22%), despite the fact that Gillberg did not include this as a diagnostic criterion in this study. Circumscribed interests were found in 99% of the Asperger's syndrome cases and only 30% of the autistics. This must have been largely due to his diagnostic criteria for Asperger's syndrome, which included "special interests". No differences emerged on the neurobiological tests. Gillberg and his colleagues (Gillberg, 1989; Gillberg, Steffenberg & Jakobsson, 1987) conclude that Asperger's syndrome patients are "different in the sense that they are not so pervasively impaired as Kanner-autism "prototype" children".

Most researchers, then, seem quite happy to say that Asperger's syndrome is a label for high functioning autistics. But what is meant by terms such as "high functioning" and "able autistic"? Newson, Dawson and Everard (1984) studied a large group of "able autistics", contacted through a national advertising campaign, and report a very varied picture. Insistence on sameness, for example, was seen to widely varying degrees among autistic people of apparently equal "ability". This great variation even among those autistics who have a relatively mild handicap, suggests that by no means all of the Newson group could be described as having Asperger's syndrome. For example, only 54% of the subjects had a collection, and only 4 out of the total of 93 parents could say that they had not been concerned about the development of language; only 27 of the 93 autistic subjects had reached the two word stage by age 3 years. By the proposed ICD-10 criteria for autism,

at least, few of the Newson sample would have received a diagnosis of Asperger's syndrome.

A study by Rumsey and Hamburger (1988) also suggests that there is a group of "high functioning" autistics that do not fit the description of Asperger's syndrome. They tested 10 "able autistic" men with normal IQs against 10 normal controls. Tests revealed no differences in motor skills between the groups. The authors stress the "similarity between the Wechsler profile for [their] sample and that of lower functioning samples (Lockyer and Rutter, 1970)". This result strongly suggests that high ability, in terms of IQ at least, is not enough to transform a typical autistic picture into an Asperger's syndrome picture. Equally, Tantam (1986) found adults whom he diagnosed as having Asperger's syndrome, who had low intellectual ability.

It seems, then, that a "mild form of high functioning autism" is not necessarily Asperger's syndrome - one may have a relatively mild handicap and be autistic without conforming to the Asperger's syndrome subtype. This suggests that a very fruitful line of research may be the exploration of significantly distinct subgroups among the autistic spectrum. One such study, by Volkmar, Cohen, Bregman, Hooks and Stevenson (1989), used Wing's subtypes of "aloof", "passive" and "active but odd" social behaviour to categorise a group of autistic and PDD children. Although these styles of social impairments can be shown concurrently by the same child in different situations, the authors claim (as do Wing and Gould, 1979) to have been able to assign subjects to one of the three groups on the basis of predominant style of social behaviour. The results are interesting and should encourage specific investigation of such subtypes with the diagnosis of Asperger's syndrome in mind. The authors found significant differences between the children in the three social impairment subgroups. For example, social type was strongly related to IQ, with "active" children most and "aloof" children least intelligent. Special abilities were significantly more common (80% prevalence) in the "active" group. Siegel, Anders, Ciaranello, Bienenstock and Kraemer (1986) also looked for subtypes among autistic and "autistic-like" children, on the basis of current functioning. They derived four groups which they say are an advance on current diagnostic categories, since they identify co-occurring behaviours and assign children to more homogenous subtypes.

Although Siegel et al's subjects are grouped on the basis of current functioning, the groups derived also differed in history of pre- and peri-natal problems, and early development. Asperger's syndrome approximates most closely to subtype 3, characterised by better language, and some schizoid features.

The only other satisfactory attempt at finding subtypes within the autistic spectrum comes from Tantam (1986), who rejects the claim that Asperger's syndrome is simply high-functioning autism, since the same picture (including active but odd social behaviour) can appear at almost any IQ level. He speculatively suggests that there are 2 syndromes of "more able autism";

Type 1 - overtly eccentric people, with special interests. These patients have an obviously odd social manner, and peculiar mannerisms and movements (that lead to a high "express" score on Tantam's tests). They are verbose, which may lead to their intelligence being somewhat overestimated by VIQ tests. Not all, but many, score more highly on verbal than performance IQ tests. These patients have a well developed sense of propriety. Type 1 approximates to Asperger's syndrome.

Type 2 - show more autistic symptoms in childhood. They have less well-developed interests, and are less interested in objects. Nonverbal expression is more absent than odd in this group. They look innocent and child-like, and are naive and passive in social situations. Their IQ is in general lower than type 1 patients, but there is some overlap. This group is more likely to have made serious attacks on people.

Tantam's two types are an advance over the idea that Asperger's syndrome is simply "high-functioning" autism. They have implications for management and prognosis. In addition, although for Tantam these are empirically and not theoretically derived subgroups, the two types are amenable to explanation at a level beyond surface behaviours. One might put forward the hypothesis that types 1 and 2 differ in their theory of mind capacity, and offer this as the explanation of their different symptom patterns. A plausible and testable hypothesis might go as follows; type 1 subjects have developed some theory of mind capacity after gross delay, while type 2 subjects have no theory of mind. Type 1 subjects therefore are more actively sociable, which leads them to reveal the effects of gross delay in the acquisition of theory of mind in their odd nonverbal communication. Specifically,

type 1 subjects will have some insight into the fact that people communicate feelings and beliefs, both verbally and nonverbally - and they will attempt to do so. Their more fluent language would also follow from their better theory of mind ability (see chapter 5). Lastly, the type 1 person would be less likely to attack others, since he would have more (though still imperfect) insight into the sufferings that one can inflict. Type 2 subjects would not attempt to communicate with gesture or facial expression, having no awareness of intention or of communication beyond the literal. They would therefore appear "flat" rather than odd. For similar reasons of theory of mind deficit they would be more likely to attack others, and so on.

Conclusions

Throughout this chapter I have argued that theory must inform the search for Asperger's syndrome. I have used the "theory of mind" explanation of autism as an example of how theory can make clear boundaries where surface behaviour cannot. I believe that the concept of theory of mind is a particularly good theoretical instrument for this job, since it allows one to move from a continuum of social, communicative and imaginative handicaps in behaviour, to a discrete ability that subjects may either lack or possess. It may therefore be possible to go from quantitative differences in surface behaviours to qualitative differences in cognitive deficits. This may help in the making of principled distinctions between some of the apparently similar disorders discussed in this chapter. Importantly, such distinctions will have significant implications for prognosis, education and management (see chapter 9).

The theory of mind explanation has been suggested here as a tool for distinguishing meaningful subgroups, but the more important point is that a hypothesis of some sort should guide the exploration of Asperger's syndrome. Testing groups of subjects labelled "Asperger's syndrome" by clinicians cannot be a helpful way to proceed until we have at least a consensus on the matter of necessary and sufficient diagnostic criteria. And we are unlikely to reach a satisfactory diagnostic scheme for Asperger's syndrome until we look beyond surface behaviours to the underlying

cognitive handicaps. ICD-10 for example is in danger of excluding, without good theoretical or empirical grounds, those children who change from a Kanner- to an Asperger-type picture in adolescence.

Is there any escape from this "chicken-and-egg" situation between diagnosis and research? My suggestion is that researchers should look for meaningful subgroups in the population of autistic people and those patients with related disorders. Theory should guide the search for subgroups, and clinical experience should tell us which subgroups deserve a label. Clinicians may feel the need to continue using Asperger's syndrome to label a (for them) "recognisable" subtype of autism - but researchers have no excuse for accepting definitions and diagnostic criteria as confused and confusing as currently appear in the literature on Asperger's syndrome.

In the following experimental investigations, subjects were included according to whether they reached established criteria for autism (DSM-III or DSM-III-R). The diagnosis of Asperger's syndrome had been given to some subjects in addition, but this fact did not influence subgrouping - which was based instead on theoretical criteria.

Chapter 3

The Theory of Mind Battery

Introduction

The finding that only approximately 20% of autistic subjects pass a first-order false belief task has been taken as strong support for an explanation of the autistic handicap in terms of a lack of theory of mind (see chapter 1). However, that even 20% should pass has been seen by some critics (eg. Ozonoff et al, in press; Bowler, 1989) as damaging to the explanatory power of the theory. The response to such criticism has taken two directions (cf p.39). Either the success of these few subjects is regarded as genuine proof of their possessing a theory of mind - in which case their handicaps are seen as due to the gross delay in acquisition (Baron-Cohen, 1989a); or the success of this 20% is seen not as proof of theory of mind ability but rather as evidence of the "hacking out" of some strategy for solving the tasks (Frith et al, 1991).

As was suggested in chapter 1, there is little empirical evidence to suggest which of these two very different accounts is correct. In the first experimental study, the aim was to explore the consistency of performance by autistic subjects tested on a range of theory of mind tasks. Testing subjects with a battery of different theory of mind tasks should reveal inconsistencies in the performance of subjects who are using specific, non-theory of mind strategies. Normal children, on the other hand, come to pass widely varying tests of theory of mind at the same age and show generalisation of these skills across situations and to novel scenarios (Gopnik & Astington, 1988; Moore, Pure & Furrow, 1990). The performance of mentally handicapped subjects, who are commonly used as controls in studying autistic theory of mind failure, has never been established across an array of theory of mind tasks. In this experiment autistic subjects who passed the Sally-Ann task were tested, and their consistency across a battery of tasks was compared with that of normal 6 to 9 year olds, and mentally handicapped children and adults. Significantly greater

inconsistency in the autistic subjects' performance would support a "strategy" view, while generalisation of skill across tasks would support the "delay" hypothesis.

A second aim of the present study was to attempt to replicate recent work by Bowler (1989), who found that most (11/15) of his able autistic subjects performed as well on a second-order false belief task as did normal controls. This finding was in contrast to Baron-Cohen (1989a) who found that none of his autistic subjects, who were selected on the basis of passing the Sally-Ann task, passed Perner and Wimmer's (1985) ice cream van story. The present battery therefore included both first- and second-order tasks.

In addition to second-order false belief tasks, the theory of mind battery included two versions of a second-order deception task. This task was devised to see whether even those autistic people who might (as in Bowler's study) pass second-order false belief tasks, could still be "tripped up" by a yet harder, double bluff task. Autistic subjects had not before been tested on second-order deception tasks, and the hope was that double bluff might prove to be a test sensitive to the impairments of even the most able autistic subjects.

The deception tasks devised also served another purpose. Russell and his colleagues (Russell et al, 1991; Hughes & Russell, 1990) have suggested that the autistic subject's difficulty with deception tasks springs not from the necessity for mental state understanding, but rather from the demands these tasks make upon executive control functions. Russell suggests that autistic people have a deficit in executive control, and therefore find deception and false belief tasks hard only because they involve planning, inhibition and monitoring. In particular, Hughes and Russell argued that all the deception tasks autistic subjects fail, are failed if the subject indicates the true location of the object. They predicted that if this were not a feature of the tasks - a feature which necessitates inhibiting a response - autistic subjects would not find deception tasks difficult. The first- and second-order deception tasks presented here allow this hypothesis to be tested, since in each case the correct (deceptive) answer is to indicate the true location of the hidden object/person. In the first-order task, this is the case because the story character has a false belief about the location of the object - and so in attempting to indicate the

empty location they actually indicate the full box. In the double bluff tasks, the character deliberately indicates the real location of the object, with a deceptive intent, because they know that they will be expected to lie.

In addition, the theory of mind battery allows comparison of the relative difficulty of different tasks (deception versus false belief) and the effects of task level (first-versus second-order) on the performance of normal, mentally handicapped and autistic subjects.

Lastly, the battery allowed individual subject's theory of mind ability to be more confidently assessed, permitting an investigation of the relation between performance and verbal justification on the second-order tasks. In previous studies (Baron-Cohen, 1989a) the ability to provide a mental state justification for answers to second-order false belief questions has been taken as necessary evidence of true comprehension. However, Bowler found that normal subjects tended not to give mental state justifications to the ice cream van story. Why his normal adults did not give advanced justifications but Baron-Cohen's mentally handicapped children did is unclear. However, there is an extensive literature on the distinction between the acquisition of implicit and explicit verbally-accessible knowledge in normal development (eg. Karmiloff-Smith, 1986). It therefore seems important to assess the validity of the justification question as a measure of understanding of false belief and deception.

To summarise, then, the aims for this series of experiments were as follows;

- 1) To test the "strategy" hypothesis, by looking for inconsistencies in autistic success.
- 2) To attempt to replicate the findings of either Bowler (1989) or Baron-Cohen (1989a) concerning the upper limit of autistic theory of mind success.
- 3) To test subjects on a new and harder second-order deception task.
- 4) To test Russell's hypothesis that deception is only difficult for autistics when the correct response is to indicate the place where the object is not.
- 5) To examine the relative difficulty of false belief and deception, and of first- and second-order tasks, for the different subject groups.
- 6) To assess the relation of verbal justification to performance and competence.

Method

The experiment had a repeated measures design. The independent variables were task type (false belief or deception) and task level (first- or second-order theory of mind).

Subjects

21 autistic subjects, children and adults, who passed first-order false belief tasks were tested. These subjects were contacted either via special schools for autistic children or via a clinician who knew of autistic adults in the community. All subjects had received a diagnosis of autism according to DSM-III-R criteria. 7 pupils from a school for children with moderate learning disability (MLD), and 5 mentally handicapped adults from a long-term institution were used as controls. The autistic subjects were given either the WISC-R or WAIS, according to age, while the MLD controls were given the British Picture Vocabulary Scale (BPVS). All but one subject had an MA over 4 years; this subject, an MLD adult, was included because of his good understanding of the tasks and correct performance despite his low MA. Four autistic subjects were not IQ tested, due to time limitations or school policy.

It was not possible to match the MLD controls to the autistic subjects on IQ, due to the unusually high ability of many of the autistic subjects. Instead, the MLD group had lower mean verbal MA and verbal IQ than the autistic group. Poor performance shown by the autistic subjects cannot therefore be due to low general intelligence.

A group of 31 normal children also acted as controls. IQ was not assessed in this group, and MA was assumed to approximate CA - making these subjects less advanced than the autistic subjects.

Full subject characteristics are shown in table 3.1.

Table 3.1

Subject Characteristics for Theory of Mind Battery
(group means, ranges given in brackets)

GROUP	N	AGE	VMA	VIQ	PIQ	FIQ
Normal Children	31	8:2 (6:5-9:6)	-----	-----	-----	-----
Young MLD Controls	7	12:7 (12-13:6)	7:10 (4:5-10)	68.6 (40-89)	-----	-----
Older MLD Controls	5	27:1 (19:3-38)	6:10 (3:10-11:10)	43.8 (40-59)	-----	-----
All MLD Controls	12	19:9 (12-38)	7:4 (3:10-11:10)	56.2 (40-89)	-----	-----
Young Autistics	9	13:6 (8:9-16:2)	8:7 (5:7-15:6)	81.5 ^a (58-101)	92.8 ^a (64-123)	85.5 ^a (60-112)
Older Autistics	12	23:4 (17:6-45:1)	-----	85.5 ^b (66-100)	88.8 ^b (72-112)	85.7 ^b (69-102)
All Autistics	21	19:7 (8:9-45:1)	-----	84.1 (58-101)	90.2 (64-123)	85.6 (60-112)

^a from 6 subjects only.

^b from 11 subjects only.

Materials

The tasks in the theory of mind battery were performed along the lines of Baron-Cohen et al (1985) and Baron-Cohen (1989a). For the first-order tasks, a smartie tube containing a pencil was used (as in Perner et al, 1989), a set of three small cardboard boxes of different sizes, shapes and colours served as hiding places, and a ten pence piece was the object hidden. The characters were either real people or two lego figures of distinct appearance, one male and the other female. The "baddie" in the deception tasks was either a third lego figure of a burglar, or a glove puppet pig.

For the second-order tasks, the village was a cardboard scene, with locations (church, park, John's house) drawn in and labelled. No child raised objections to this 2-dimensional scene, and all accepted when story characters had "gone away" (under the table) and could no longer see or hear one another. All characters in these stories were lego figures; Mary, John and Burglar Bill from the first-order tasks, plus new figures for the ice-cream man in his van, Simon, Bob and the policeman on his motorbike.

Subjects' responses to questions, and the use of prompts, were recorded on standard scoring sheets.

Procedure

Subjects were tested alone in a quiet room. The second adult in the first-order tasks was either another experimenter or a teacher from the school. All subjects were given first-order false belief tasks first, followed by first-order deception, followed by second-order false belief, and finishing with second-order deception. However, the order of tasks within these groupings was balanced across subjects (i.e. the order in which subjects received the four first-order false belief tasks was varied systematically). Only subjects who passed all four first-order false belief tasks were included in this experiment. Subjects who failed any of the control memory questions were also excluded. The protocols for the tasks used can be found in appendix I.

Results

The group means (and standard deviations) can be seen in table 3.2, and are presented graphically in figure 3.1.

Table 3.2

Results from Theory of Mind Battery
(group means, standard deviations in brackets)

GROUP	FIRST-ORDER		SECOND-ORDER	
	False Belief max = 4	Deception max = 4*	False Belief max = 4	Deception max = 4
Normal Children	4.00 (0)	4.00*(0) 2.00*(0)	3.32 (1.3)	3.90 ^c (0.4)
MLD Controls	4.00 (0)	3.52*(0.5) 1.75 (0.5)	3.92 ^b (0.3)	3.42 ^c (0.9)
Autistics	4.00 (0)	3.04*(0.6) 1.52*(0.6)	2.67 ^b (1.6)	1.71 ^c (1.8)

* Scores on the first-order deception tasks (scored out of 2) were doubled to allow easy comparison with other scores.

^a ANOVA $F(2,61)=9.23$, $p<0.000$. Tukey studentized range method, $p<0.01$.

^b ANOVA $F(2,61)=3.82$, $p<0.027$. Tukey, $p<0.05$.

^c ANOVA $F(2,61)=24.72$, $p<0.000$. Tukey, $p<0.01$ (Autistics<MLD and Normals).

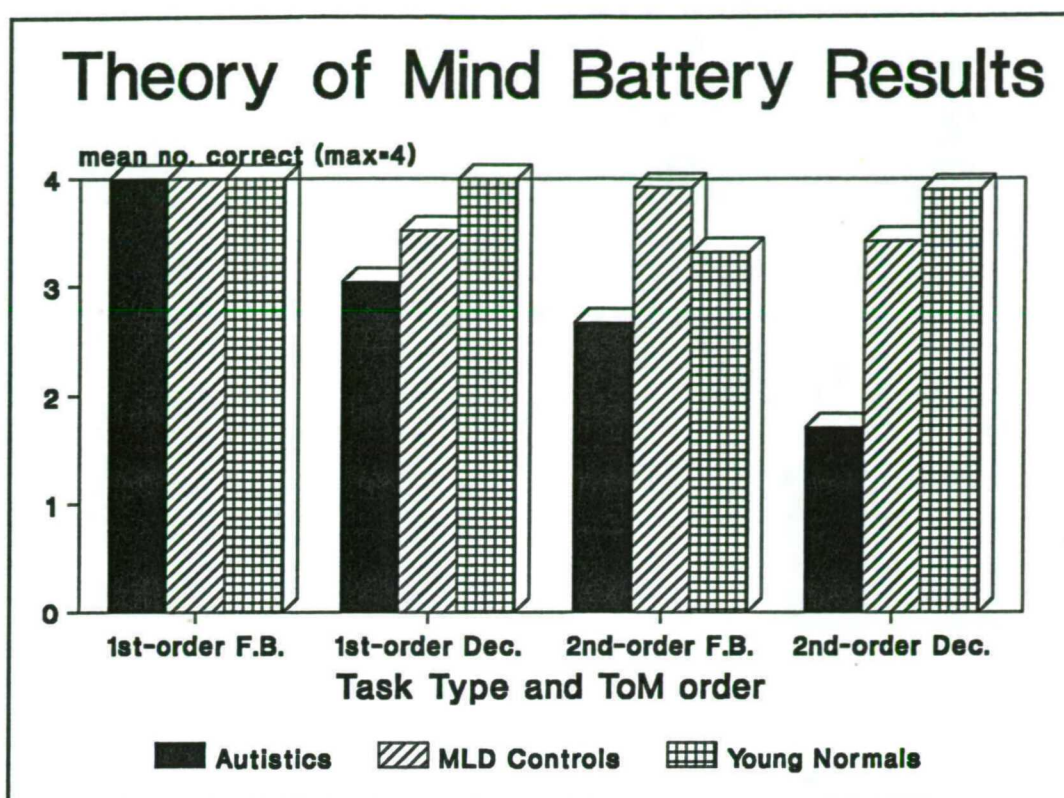


Figure 3.1 Theory of mind battery results

Group Differences

As can be seen in table 3.2, even a group of autistic subjects equated for first-order false belief performance showed significant deficits on a theory of mind battery. Consistency was a great deal lower in the autistic group, compared with the retarded and normal controls. Of the 21 autistic subjects who passed FB1 (ie. scored 4/4), only 5 passed all other tasks. (Note that, for the purpose of these analyses, "pass" means scoring full marks). That is 24%, compared to 58% of the MLD (7 of the 12) and 68% of the normal children (21 of the 31) passing all tasks (see figure 3.2). These frequency results, and those reported below, were analysed with chi square tests followed by Page's trend tests. This analysis confirmed that significantly fewer autistic subjects passed all the tests compared to either the MLD subjects ($p < 0.02$) or the young normals ($p < 0.001$). A 2-way analysis of variance was not considered appropriate because of the homogeneity of variance of the first-order false belief scores.

Theory of Mind Results

% Ss passing all tasks

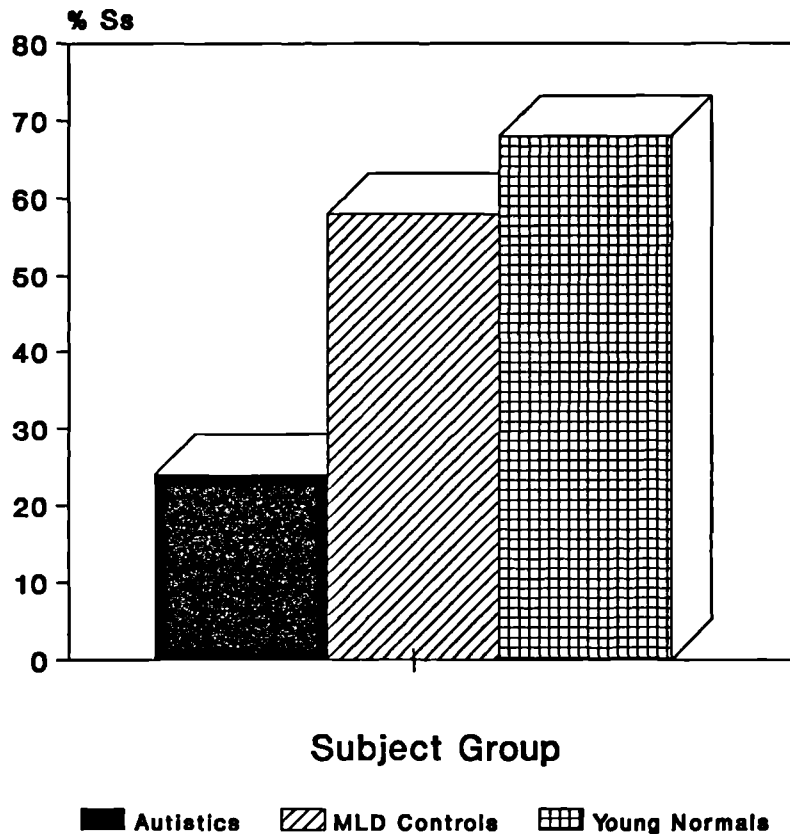


Figure 3.2 Percentage of subjects passing all tasks

Performance versus Justification (Second-order tasks)

In the normal children and MLD controls, very good performance was necessary but not sufficient for very good justification. This pattern held for both deception and false belief tasks. Since some subjects scored 8/8 on performance but 0/8 on justification, it seems likely that using the justification score to assess theory of mind ability may lead to false negative judgements.

In the autistic group, however, different patterns emerged on the deception and false belief tasks. On false belief tasks, very good performance was necessary but not sufficient for any justification. This pattern is essentially like that of the controls, but with a greater lag between performance and justification. However, on the deception tasks very good performance was both necessary and sufficient for any justification. Essentially then, if the autistic subjects could do it well they could attempt to talk about it.

Deception versus False belief

The autistic subjects found second-order deception much harder than did the other groups. The deception - false belief differences are reflected in the percentages of subjects scoring full marks on these tasks (table 3.3):

Table 3.3 Percentage of subjects passing all false belief or deception tasks

Group	Passing all False belief		Passing all Deception	
	%	No.	%	No.
Autistic Ss.	48%	10/21 ^a	29%	6/21 ^b
MLD Ss.	92%	11/12 ^a	58%	7/12 ^b
Normal Ss.	71%	22/31	94%	29/31 ^b

^a Significantly fewer autistic subjects than MLD controls pass all false belief tasks (Chi square=7.1, $p<0.03$; Page's trend test $p<0.01$).

^b Significantly more young normals than MLDs or autistics pass all deception tasks (Chi square=10.0; Page's test $p<0.01$), and significantly fewer autistics than MLDs pass all deception tasks (Page's test $p<0.01$).

Alternatively, the relative difficulty of the two types of task for the different subject groups can be assessed by comparing the number of subjects who pass false belief but not deception tasks at each level (table 3.4, figure 3.3);

Table 3.4 Percentage of subjects who pass false belief but not deception

Group	1st-order tasks		2nd-order tasks	
	%	No.	%	No.
Autistic Ss.	43%	9/21 ^a	40%	4/10 ^b
MLD Ss.	25%	3/12 ^a	27%	3/11
Normal Ss.	0%	0/31 ^a	4%	1/22 ^b

^a Chi square=15.5, $p<0.001$; Page's trend test shows autistics differ significantly from MLDs ($p<0.05$) and from young normals ($p<0.01$).

^b Chi square=6.4, $p<0.05$; Page's trend test shows autistics differ significantly from young normals ($p<0.05$).

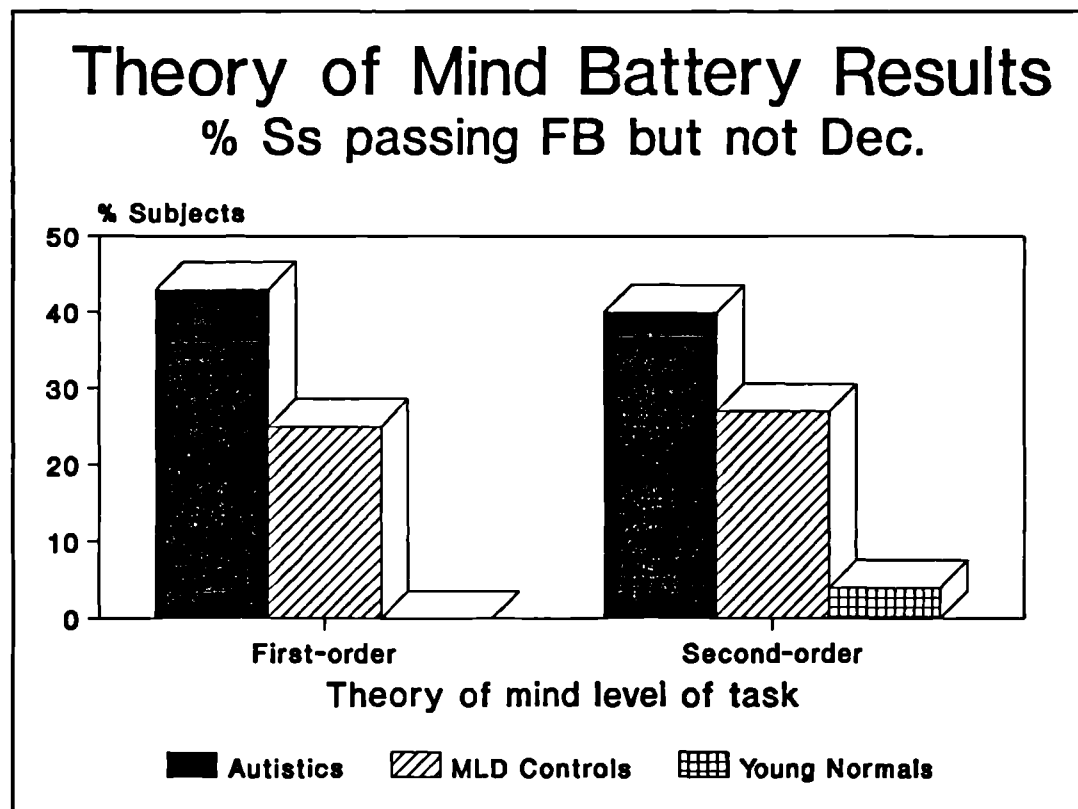


Figure 3.3 Percentage of subjects passing false belief but not deception tasks

These figures show that while task type (deception versus false belief) affects the performance of very few of the young normal subjects, it reduces the performance of approximately a quarter of the MLD subjects, and nearly half of the autistic subjects. These differences are significant on chi square and Page's trend tests; more autistics than MLDs are inconsistent, and both of these groups are less consistent than the young normals. This inconsistency across tasks at the same level of theory of mind, may indicate that many of the autistic subjects are indeed using some non-theory of mind strategy that allows them to succeed only on false belief tasks.

Effects of theory of mind level (first-order versus second-order tasks)

As can be seen in figure 3.1, the autistic subjects were more affected than the controls by the change from first- to second-order in the tasks. This difference is also manifest in the numbers of subjects passing all tasks at the two levels of difficulty (table 3.5):

Table 3.5 Percentage of subjects passing all 1st- or 2nd-order tasks

Group	Passing all 1st-order tasks		Passing all 2nd-order tasks	
	%	No.	%	No.
Autistic Ss.	57%	12/21 ^a	29%	6/21 ^b
MLD Ss.	75%	9/12 ^a	67%	8/12 ^b
Normal Ss.	100%	31/31 ^a	68%	21/31 ^b

^a Significantly more MLDs than autistics pass all first-order tasks (chi square = 15.5, $p < 0.001$; Page's trend test $p < 0.05$), and significantly more young normals pass all these tasks than either clinical group (Page's test $p < 0.01$).

^b Significantly fewer autistic subjects passed all second-order tasks than either MLDs or young normals (chi square=8.6, $p < 0.01$; Page's trend test $p < 0.01$).

The effect of order can also be assessed by looking at the numbers of subjects in each group who pass the 1st-order version of a task, but fail the 2nd-order version (table 3.6 and figure 3.4);

Table 3.6 Percentage of subjects passing 1st- but not 2nd-order tasks

Group	False belief		Deception	
	%	No.	%	No.
Autistic Ss.	52%	11/21 ^a	50%	6/12 ^b
MLD Ss.	8%	1/12 ^a	22%	2/9
Normal Ss.	29%	9/31	6%	2/31 ^b

^a Chi square=7.1, $p<0.03$; Page's trend test $p<0.01$.

^b Chi square=10.6, $p<0.01$; Page's test $p<0.01$.

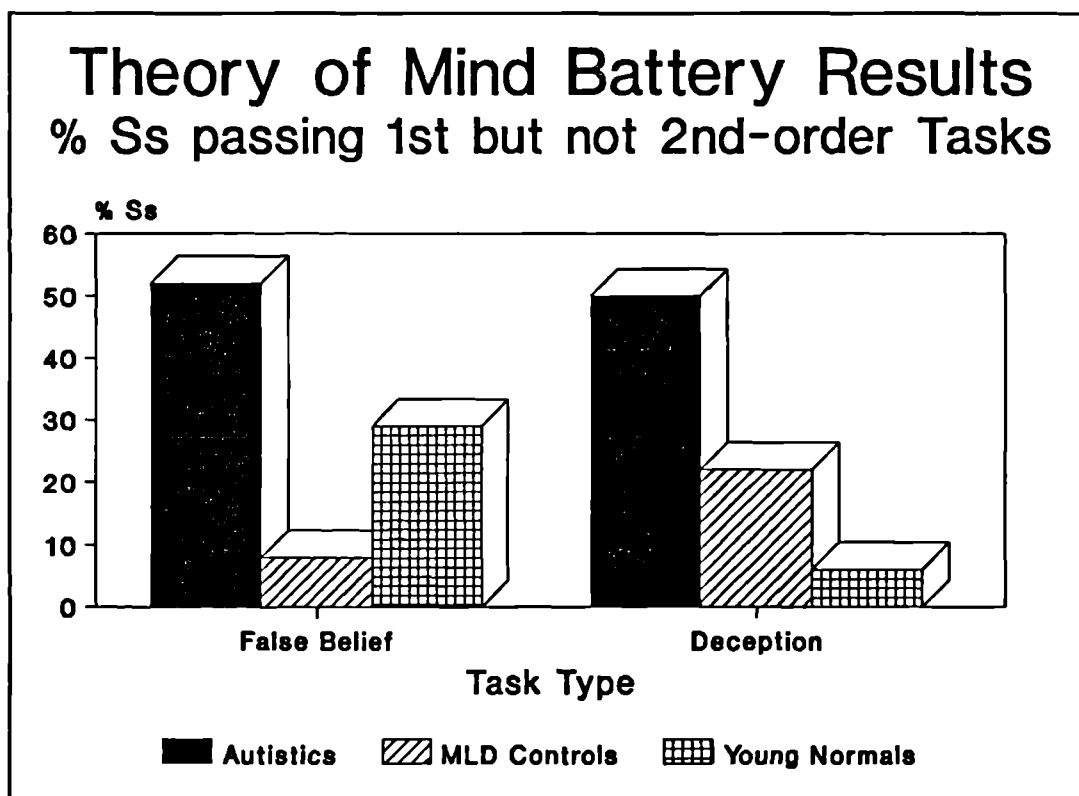


Figure 3.4 Percentage of subjects passing first- but not second-order tasks

This shows that approximately half of the autistic subjects who passed the 1st-order version of each task, failed when the task was presented in the 2nd-order theory of mind condition. In the MLD and normal control groups, the effect of order was not so great, and a majority of those who passed each task in the first-order condition also passed it in the second-order version. The autistic group were significantly different from the MLD controls in finding the second-order task harder than the first-order task for false belief, and significantly different from the young normals in finding second-order deception harder than the first-order version.

Discussion

Group Differences: On first-order tasks

The autistic subjects in this experiment were specially selected to pass first-order false belief tasks, and so they did not differ in their performance from the controls on first-order false belief.

On first-order deception tasks, the autistic subjects performed significantly worse than both the young normals and the MLD controls. Even those autistic subjects who pass false belief tasks may not pass deception tasks, found equally easy by controls. This may indicate that the autistics are using a non-theory of mind strategy that does not allow them to succeed on deception tasks. Alternatively it may be that their real theory of mind skills extend to predicting a person's actions on the basis of their false belief, but do not extend to manipulating that false belief. The literature on theory of mind development in normal children contains some evidence that the ability to deceive may lag behind the ability to comprehend another person's false belief (findings reviewed by Astington & Gopnik, 1991).

Group Differences: On second-order tasks

The autistic subjects performed significantly worse than both control groups. Even when equated with controls on first-order false belief, autistic subjects performed significantly worse on both second-order deception and false belief. This difference

may reveal the use of non-theory of mind strategies by many of the autistic subjects.

However, it remains a surprising finding that some (6) autistic subjects did pass all theory of mind tasks perfectly, and 2 even provided good justifications for their answers. This is in contrast to the finding by Baron-Cohen (1989a), that no autistic subjects passed the ice cream van task, and supports Bowler's (1989) results. The fact that here some subjects passed a whole battery of tasks suggests that we should not underestimate their competence. Revealing the non-theory of mind strategies of these subjects did not prove as easy as might have been expected - suggesting that the alternative hypothesis (that these subjects have gained "true" theory of mind) should be taken seriously. However, the results here still show that only a subgroup of autistic subjects appear to understand mental states in some situations. To date, the delay hypothesis can still be held for this subgroup, since no autistic child has been found who is capable of succeeding on theory of mind tasks at their age (or MA) appropriate level. An explanation of their difficulties in terms of a lack of theory of mind is still tenable, then, but must be modified to implicate the developmental effects of an early lack of theory of mind rather than the moment to moment effects of an inability to attribute mental states.

Performance versus Justification

The good performance of some normal children across the whole theory of mind battery, and the failure of these same subjects to provide any verbal justification, suggests that these two questions measure rather different abilities. Karmiloff-Smith (1986) has stressed the distinction between knowledge available to guide actions and knowledge available for conscious reflection and verbal report. Freeman, Lewis and Doherty (1991) suggested from their findings that normal children's theory of mind competence may not be fairly assessed by verbal measures. They found that three-year-olds performed significantly better if allowed to "act out" rather than verbalise their answer to a false belief test question. While a correct response to the justification question has been taken as a criterion for passing second-order false belief (following Perner & Wimmer's (1985) and Baron-Cohen's (1989a) procedure), its implications need careful consideration. Requiring an accurate justification from

a child may transform a task into a meta- or higher-order test, and researchers need to be clear about what ability they are testing. However, in cases where only one task is given, and it is vital to exclude false-positive passers, the justification question may be useful.

The idiosyncratic pattern of performance and justification in the autistic subjects on the deception tasks may reveal a non-theory of mind strategy used by some autistic subjects. The second-order deception tasks were initially thought so hard that every element was spelt out for the subject. Thus the experimenter inadvertently provided verbal expressions that could be used in isolation to solve both the performance and justification questions (e.g. "Wherever Bob says, the police will look in the other place"). A subject who could latch onto this phrase, which is in fact purely behavioural, could give correct answers to both questions. It seems likely that at least some autistic subjects succeeded in this way although, since deception was harder than false belief for most subjects, this strategy cannot have been widely used. It is interesting that the control groups did not use this trick, which seems so obvious once pointed out. Perhaps these subjects do not "see the trees for the wood", and in concentrating on understanding the story do not pay attention to the surface form (see chapter 7). The prediction would be, then, that introducing a similarly explicit phrase into the protocol of the false belief tasks would lead to the same pattern of justification and performance results in the autistics seen here on deception, but would leave the controls' results unchanged.

Deception versus False belief

The finding that double bluff and the version of first-order deception given here are difficult for autistic subjects, suggests that these subjects' problems do not lie simply in indicating where the target is not. Hughes and Russell's (1990) theory that autistic people are unable to "disengage from the object", cannot explain the autistic subjects' poor performance on the deception tasks in this battery, where in each case the correct answer is to indicate the object's real location. It is not clear why the autistic subjects tested here should find embedded mental states harder to understand than first-order mental states, if action-inhibition problems alone caused their poor performance on false belief and deception. However, it could be argued

that the second-order tasks, and particularly the double bluff task, required a greater degree of planning or monitoring, and therefore were significantly harder not only in terms of theory of mind but also in terms of executive functions. A non-theory of mind task of equal complexity would have to be devised to test this possibility.

Theory of Mind Battery Conclusions

The results of the theory of mind battery give a mixed picture in answer to the questions and aims proposed in the introduction. Autistic subjects equated on first-order false belief performance, performed less well on deception and second-order tasks than did normal and mentally handicapped controls. It seems likely that those autistic subjects whose success on first-order false belief did not extend to other tasks were using some non-theory of mind heuristic. However, the results also show that some autistic subjects did pass all tasks, supporting in part Bowler's (1989) finding and conflicting with Baron-Cohen's (1989a) results.

What might underlie the success of this small group of autistics? Several possibilities exist. It may be that these subjects are using very sophisticated heuristics, which happen to allow them to succeed in all our tasks. However, the most obvious explanation is that these few subjects really do possess a theory of mind. Does this then make a theory of mind deficit explanation of the autistic individual's handicaps untenable (as claimed by Ozonoff et al, in press)? The subjects who passed second-order tasks were still odd and still "looked" autistic. For example, none of them was in full-time employment, had a close reciprocal friendship, or lived independently. These subjects' handicaps may be due to a significant delay in acquiring the ability to represent mental states. This can only be a speculation at present, since no longitudinal data is available to reveal age of initial theory of mind success. However, it is possible to say that nothing in the present study contradicts the idea of delay in acquiring theory of mind in even these very able autistic subjects. The youngest subject in this study to pass first-order tasks consistently was 8:9 years old, and the youngest subject to pass second-order tasks consistently was 11:5 years old. Both subjects had above average IQ.

Therefore these subjects have developed a theory of mind quite late, both in terms of CA and relative to their MA.

Delay in acquiring the ability to represent mental states may leave scars which never heal, in terms of missed social experience and interaction. It also seems likely that a theory of mind gained so late will be odd in itself, since the usual environment for its development will have passed, and quite a different social world will feed its development. One particular problem may be the fact that such a late developing theory of mind would be out of synchrony with the other developmental processes with which it normally interacts. Perception of intention, for example, may be "fine tuned" by theory of mind in the young child, so that the individual comes to "see" without calculation the contexts where a theory of mind must be applied. Recognition of facial and bodily displays of emotion may also be "tutored" by theory of mind, leaving the child able to perceive emotions rather than having to puzzle them out. Most important of all, the emerging theory of mind mechanism must be of primary importance in the child's growing ability to recognise and process ostensive behaviour as a special class of stimuli (see chapter 5).

If the autistic child develops a theory of mind with a significant delay, these other systems would miss out on the input and tuning they might normally receive from theory of mind. This might leave the able autistic person at the age of twenty with a theory of mind but none of the input systems that back up its functioning in the normal individual. He may then fail to use the ability he has, in all but the most obviously marked theory of mind situations. The experimental tasks may present just such a "marked" context. In order to explore this possibility, a battery of slightly more naturalistic materials was developed and presented to the able autistic subjects. These materials, the "Strange Stories", and the results from that investigation are presented in chapter 4.

Chapter 4

The "Strange Stories" Test

Introduction

In the previous chapter results from a battery of theory of mind tasks were reported, and the question of whether success on such tasks was due to "true" theory of mind or merely "hacking" was discussed. While some few (6) of the autistics tested performed well on all the tasks given, the possibility remains that these subjects succeed using a non-theory of mind strategy. This would explain why, despite perfect test performance, these subjects are still socially handicapped - for example, none had a close friend, lived independently or was gainfully employed. The strategy such subjects could be using might be flexible enough to be successfully applied to slightly different surface forms of the same task, or might succeed only if the elements of visual access and information are spelt out (as they are in the false belief and deception tasks, but not in life). To test this possibility, the autistic subjects were given a set of vignettes or stories about everyday situations where people say things which they do not literally mean. It was hoped that these stories would present a somewhat more naturalistic challenge to the subjects than did the acted out theory of mind battery tasks. The aim, then, was to extend the range of tasks involving theory of mind to a more contextually embedded and realistic form, which might be expected to "trip up" even those subjects who succeeded on the previous, simplified tasks.

The stories were not imaginative or highly fictional, but concerned the different motivations that can lie behind everyday utterances which are not literally true. So, for example, if someone asks your opinion of a new dress which you actually think is hideous, you might say it was nice for a variety of different reasons; to spare their feelings, to mislead them into wearing it and looking awful, to be sarcastic, or to be funny. In everyday life these different motivations will be distinguished by many factors, such as preceding context, emotional expression, and relationship between speaker and hearer. The stories used here were written to be unambiguous,

so that only one interpretation of the situation would be made by normal and non-autistic mentally handicapped subjects. The prediction was that autistic subjects' performance would show a strong relation to their performance on the theory of mind battery. The precise relation of the subjects' performance on the two test batteries should reveal something about the cognitive processes underlying their success or failure on the traditional (false belief) tests of attribution of mental states. Control stories, involving only the understanding of physical events, were also given to the subjects, to check the generality of any comprehension deficit which might emerge regardless of content.

Method

Subjects

The stories were given to 24 autistic subjects. This group included 18 of the 21 able subjects who completed the theory of mind battery, all of whom passed first-order false belief tasks (referred to below as the "able autistics"). Subjects 179, 187 and 194 were unable to take part in this experiment. In order to examine the nature of the "able autistic" subjects' success, subjects were selected from the 18 individuals to form two groups. Subjects who performed most consistently well at first-order tasks but failed second-order tasks made up a "first-order theory of mind" (1st ToM) group, and subjects who performed consistently well at both first- and second-order tasks (scoring at least 6/8 on the second-order tasks) made up a "second-order theory of mind" (2nd ToM) group. Other subjects, who performed inconsistently (or were unavailable for later testing) were excluded from these groups. It is important to stress that the labels given to the two "theory of mind" groups of autistics were not intended to make strong claims about their underlying theory of mind competence. Rather the labels refer to the subjects' level of performance on the theory of mind tasks. The nature of the processes underlying their successful performance was still an open question at this point. The subjects in the "first-order theory of mind" and "second-order theory of mind" groups were, however, considered to be the best candidates for possessing "true" theory of mind, since their performance was consistent at one or both of the two levels.

In addition, 6 of the cleverest autistic subjects who had been tested during the search for subjects for the theory of mind battery study, but who had failed first-order false belief tasks, also received the story materials. These subjects are referred to as the "no theory of mind" (no ToM) group.

Controls for this experiment were a) the MLD subjects from the theory of mind battery, plus two MLD adults who did not score perfectly on first-order false belief but who performed well otherwise across the battery; b) a subset (26) of the 31 normal children who took part in the theory of mind battery; and c) a group of 10 normal adults. The adults were volunteers, most of whom were students at London University. Subject characteristics can be found in table 4.1. Both the "able autistic" group and the MLD control group showed a preponderance of males, while the normal adult and child groups were made up of equal numbers of male and female subjects.

**Table 4.1 Subject Characteristics for "Strange Stories" Battery
(Group means and ranges)**

Group	No.	Age mean (range)	VIQ mean (range)
Young Normal Controls	26	8.6 (6.6-9.7)	--- -----
Normal Adults	10	20.5 (15-24)	--- -----
MLD Controls	13	19.4 (12-38)	56.9 ^a (40-89)
Able Autistics (FB1=4/4)	18	20.6 (8.9-45.1)	87.3 ^b (64-101)

^a from BPVS.

^b from WISC-R or WAIS.

Autistic Subjects grouped by theory of mind performance:

Group	No.	M:F	Age mean (range)	VIQ mean (range)
No ToM Autistics	6	2:1	17.6 (13.5-28.2)	62.3 ^{ad} (52-76)
1st ToM Autistics	6	5:1	16.7 (8.9-24.6)	81.8 ^c (65-100)
2nd ToM Autistics	6	6:0	17.7 (11.5-25.5)	95.8 ^{*d} (90-101)

*From 5 subjects only.

ANOVA $F(2,14)=11.39$, $p<0.001$.

^c No ToM autistics < 1st-order ToM autistics, Tukey's test $p<0.05$.

^d No ToM autistics < 2nd-order ToM autistics, Tukey's test $p<0.01$.

As can be seen in table 4.1, the autistic subjects who failed the theory of mind tasks had significantly lower VIQ than those who passed. This finding will be discussed in chapter 6, in relation to the predictions of the causal model concerning theory of mind and relevance theory presented in chapter 5. It is important to note, however, that the no-theory of mind autistics were matched for VIQ with the MLD controls, and so any relative deficit in the autistic group cannot be due simply to generally low verbal ability. Similarly, the first-order and second-order theory of mind groups did not differ significantly in VIQ, and so differences between these two groups are also not simply due to general ability differences.

Materials

The set of "Strange Stories" consisted of 24 short vignettes, each accompanied by a picture and two test questions; the comprehension question "Was it true, what X said?", and the justification question "Why did X say that?". There were 12 types of story, and 2 examples of each story type. The 12 story types comprised: Lie, White Lie, Joke, Pretend, Misunderstanding, Persuade, Appearance/Reality, Figure of Speech, Sarcasm, Forget, Double Bluff and Contrary Emotions. A set of six control "physical stories" were also given to the subjects. These stories did not involve mental states, but instead described an unforeseen outcome with a mechanical-physical cause (for example, a powercut causing a meal to be uncooked). The 24 experimental stories and the 6 control stories can be found in appendix II.

Procedure

The MLD and autistic subjects were tested alone, in a quiet room in the subject's school or home. The set of stories was introduced as follows; "Here are some stories, and some questions. I'm going to read out the stories and I'd like you to listen carefully, and help me with the questions at the end of each story". Most subjects finished all the stories in one testing session, but breaks were given as needed. Each story was read out to the subject - except where the subject preferred to read the story out loud to the experimenter. The story remained in front of the subject throughout to minimise memory requirements. At the end of the story the subject was asked the two (or sometimes three) test questions. The first question, "Was it true, what X said?", was treated as a test of comprehension. Therefore, although the first response was recorded, if the answer was wrong the story was read out again, until the subject answered correctly or justified their answer and appeared to understand (eg "it's not literally true, but it's not a lie"). The second question; "Why did X say that?" was then asked, and the subject's answer was recorded in full on a scoring sheet, for later analysis. Positive comments were made throughout the testing session to encourage the subject, but no feedback was given about the correctness of their answers. Administration was adjusted to the

requirements of the subjects, with repetition where necessary, and so length of time required varied greatly (from approximately 20 minutes to 1 hour). Prompts were given only in order to establish sufficient understanding of each story to correctly answer the "Was it true..?" question. So, for example, a subject might be reminded in the white lie story that Peter did not like his aunt's hat, by the additional prompt, "What did Peter think of the new hat?". In a few cases, subjects would not answer the "Why?" question. Details of the frequency of such omissions are given below.

The normal subjects received the stories in a slightly different way. The normal adults were given the set of stories to take away and complete overnight, with specific instructions not to ask advice from other people. The young normal children were all from a village primary school in Sussex. The stories were given to their class teacher who incorporated them into the day's activities. The children spent ten minutes each day working through the stories individually and on their own. The teacher insured that children did not confer, and she herself only helped the children with problems in reading the stories, understanding specific words, or spelling their answers. Instructions were added to the front of the booklet of stories for this group, and these can be found in appendix II.

For each subject the stories were presented in randomised order, and the two examples of each story type were not placed together.

Omissions were recorded on at least one item for 2 of the 10 adult controls, 14/26 normal children, 4/13 MLD subjects, and 12/24 autistic subjects. The number of autistic subjects failing to give an answer to at least one item, did not differ significantly from the number of MLDs ($X^2=1.24$, df.1), young normal children ($X^2=0.08$), or adult controls ($X^2=2.58$) who scored at least one omission. However, the average number of omissions per subject was greater in the autistic and young normal groups than in the MLD and normal adult groups. Omissions occurred for 6.6% of all items in the autistic group, and to 4% of items in the young normal controls, compared with 1.9% and 1.3% for the MLD and adult controls respectively. The higher incidence of omissions by the autistic subjects (between 0 and 9, average 1.6) may be due to the relatively greater difficulty of the test

questions for this group. This interpretation is supported by the fact that the autistics in the second-order theory of mind group gave on average only 0.2 omissions while the other autistic subjects gave on average 2.1 omissions. The relatively high incidence of omissions in the young normal sample (number of omission by a subject ranged from 0 to 5, with an average of 1) probably reflected the rather different testing procedure in this group. The difference in number of omissions across the different diagnostic groups, does not invalidate the analysis of the results below. Results are analysed in terms of total correct, a score to which omissions do not contribute, reflecting their status as probable indications of inability to answer the test question. Results in terms of number of correct mental state answers are also analysed. The greater number of omissions by the autistic subjects is unlikely to contribute to differences (fewer correct responses are predicted from the autistic versus control groups) on this measure, since the autistic groups did not give significantly fewer responses of any other type (mental state incorrect, and right or wrong physical state). Analysis of mental state errors will, presumably, be underestimated rather than overestimated by the tendency of autistic subjects to give fewer responses (and so makes for a conservative test of the prediction that autistic subjects will have selective problems with mental state understanding).

Scoring Procedure

The justifications given in response to the "Why?" question were rated as either correct or incorrect. A justification could be incorrect because it involved errors about the facts given in the story, or because it involved an inference which was inappropriate as a reason for the story character's utterance. So for example, in the lie story, in which Anna breaks a vase but tells her mother that the dog did it, the justification "Anna did not break the vase", would be scored as incorrect because it includes a factual error. A justification that "Anna was just joking" would also be scored as incorrect, because in the context of the story it is not appropriate to interpret her utterance as a joke. This latter judgement of appropriateness was clearly a subjective one, but a good degree of inter-rater agreement was reached as to the correctness/incorrectness of the subjects' answers (see below).

The justifications were also scored as involving mental states or physical states. Many of the story characters' utterances could be justified correctly either in terms of mental states or physical states. So, for example, in the joke story where a boy calls a dog an elephant, this can be correctly explained by the physical justification, "the dog is big like an elephant", or the mental state justification, "He's just joking". Mental state answers included all those which referred to thoughts, feelings, desires, traits and dispositions. Mental state justifications included terms such as like, want, happy, cross, afraid, know, think, joke, pretend, lie, to fool someone, expecting. Justifications were scored as physical state when they referred to non-mental events - physical appearance, action of objects, physical events and outcomes. Physical state answers included terms such as big, looks like, is shaped like, to get rid of them, to sell them, because of the X (object), to not get X (physical outcome, eg. put in jail, have a filling). In general the distinction between mental and physical state answers was clear. However, in a few cases the distinction was more difficult to make. For example, while "greedy" was classed as mental state (referring to a disposition), "hungry" was classed as physical state (referring to a bodily state). There was good inter-rater agreement on the mental-physical distinction in general, with only a few exceptions (see below).

In every case, correct took precedence over incorrect, and mental state over physical state justifications. That is, if a subject gave one correct answer and one inappropriate answer, the correct answer was taken. Similarly, if a subject's answer appealed to both physical and mental states, the justification would be scored as mental state. In each case only one rating was given per story, giving the subject credit for their "best" answer.

Covalidation of the Scoring Procedure

Since the justifications given by the subjects were judged subjectively as correct or incorrect, and as concerning mental or physical states, covalidation of the scoring was necessary to establish validity. The justifications given by every subject tested, to one story of each type, were given to a second rater. This rater was not a psychologist and was naive to the hypothesis being tested. In addition, the identity and diagnostic group of the subjects was not available to the second rater. She was

asked to mark each response with a tick or cross according to whether the response provided an appropriate answer to the test question ("Why did she/he say that?"). In addition the rater marked the answers as either concerning mental states or physical states. She was given some examples of each type of justification, taken from the stories not included for co-rating, to illustrate these ratings. These examples can be seen in appendix II.

Ratings made by the experimenter and by the second rater were compared. The degree of agreement is shown in table 4.2 - which gives the number of justifications which were judged by both raters as correct versus incorrect, as mental versus physical, and as correct/incorrect mental versus correct/incorrect physical (ie. identical ratings). The degree of concordance was calculated for each story type separately, and table 4.2 shows the mean of these percentages of agreement (appendix II shows the percentage of concordant ratings for each story type).

Table 4.2

Percentage (and number) of concordant ratings of Justifications

Both: Correct vs Incorrect		Mental vs Physical	Same
mean	98.1%	98.9%	97.3%
range	92.9%-100% (66/71-72/72)	97.2%-100% (70/72-73/73)	91.6%-100% (65/71-73/73)

Disagreements between the two raters were easily reconciled on short discussion. In most cases the discordant ratings of correct/incorrect were due to slightly stricter criteria being used by the experimenter (eg. second rater rated "he thinks it's the sea" and "they're sitting in the table" as correct justifications for the pretend story, while the experimenter rated them as incorrect). Discordant ratings of mental/physical state were largely due to slips on the part of one or other rater (eg. rating "because of the dog she was scared of" as a physical state answer, not noticing the mental state "scared") or to odd answers that were hard to rate (eg. "they're just messing about", "he had a brainstorm"). In all, 22 justifications received discordant ratings; 9 of these were given by autistic subjects, 9 by MLD

subjects and 4 by young normal subjects. While the normal adults and children were less likely than the other groups to provide answers over which the raters disagreed (in general providing clearly correct and common justifications), the autistic and MLD groups did not differ from one another in the number of hard-to-rate answers given.

Results

The physical stories proved to be very easy for subjects in all groups. No subject scored less than 5 out of 6, and no group differences emerged. Since all groups were at ceiling, performance on these stories cannot be contrasted meaningfully with performance on the "Strange Stories". Therefore the physical stories can only be treated as a screening device. However, these control stories are useful in demonstrating that where mental states are not involved, the autistic subjects in this study were able and willing to answer questions about simple stories.

On the "Strange Stories" all but 10 subjects scored 24 out of 24 on the "Is it true..?" question, which was regarded as a test of linguistic comprehension. The groups did not differ significantly on this measure; 3 of the 24 autistics, 2 of the 13 MLD controls, 4 of the 28 normal children and 1 normal adult scored 22 or 23 out of 24. These errors were mainly due to confusion over the sense of "true" intended in the question (for example, some normal subjects said that although it was not literally true that the girl in the figure of speech story had a frog in her throat, it was not untrue to use that expression).

The justifications given by the subjects in response to the "Why?" question were scored as correct or incorrect, and as concerning mental or physical states. The results for the "able autistic" group and controls can be seen in table 4.3 and fig. 4.1.

Table 4.3 **Results from "Strange Stories"**
Number of Justifications; group means and ranges

Group	Total Score (Max=24)	Correct justifications		Incorrect justifications	
		Mental	Physical	Mental	Physical
Normal Adults (N=10)	23.7 (22-24)	22.5 ^b (18-24)	1.2 ^c (0-5)	0.0	0.0 [*]
Normal Children (N=26)	21.0 (11-24)	16.7 (10-22)	4.4 (1-9)	1.9 (0-8)	0.2 [*] (0-1)
MLD Controls (N=13)	21.4 (17-24)	15.9 (12-20)	5.5 (2-10)	0.7 (0-2)	1.6 [*] (0-4)
Able Autistics (N=18)	15.7 ^a (9-21)	11.1 ^b (3-19)	4.6 (0-9)	4.8 ^d (0-11)	1.7 [*] (0-5)

^a A one-way ANOVA showed a significant effect of diagnostic group on total score ($F(3,63)=20.10$, $p<0.000$), and Tukey's test showed that the able autistics were significantly worse than all other groups ($p<0.01$).

^b ANOVA, $F(3,63)=26.8$, $p<0.000$; Tukey's test shows that able autistics gave significantly fewer correct mental state justifications than all other groups ($p<0.01$), and normal adults gave significantly more than normal children or MLD controls ($p<0.01$).

^c ANOVA, $F(3,63)=8.5$, $p<0.000$; Tukey's test shows that normal adults gave significantly fewer correct physical state justifications than all other groups ($p<0.01$).

^d ANOVA, $F(3,63)=18.4$, $p<0.0000$; Tukey's test shows that autistic subjects gave more incorrect mental state justifications than any other group ($p<0.01$).

^{*} ANOVA, $F(3,63)=18.4$, $p<0.000$; Tukey's test shows that normal children used fewer incorrect physical state justifications than did MLD or autistic subjects ($p<0.01$), normal adults used fewer incorrect physical state justifications than either MLD ($p<0.05$) or autistic subjects ($p<0.01$).

As can be seen above, the "able autistic" group, who were matched with the controls in passing first-order false belief tasks, showed significantly worse

performance on the "Strange Stories" than the control groups. Their significantly lower total score (fig. 4.1), and their tendency to give incorrect rather than correct mental state justifications (figs. 4.2 and 4.3), is striking - especially in view of their verbal IQ, which was higher than the MLD controls', and their age and experience, which was greater than the young normal controls'.

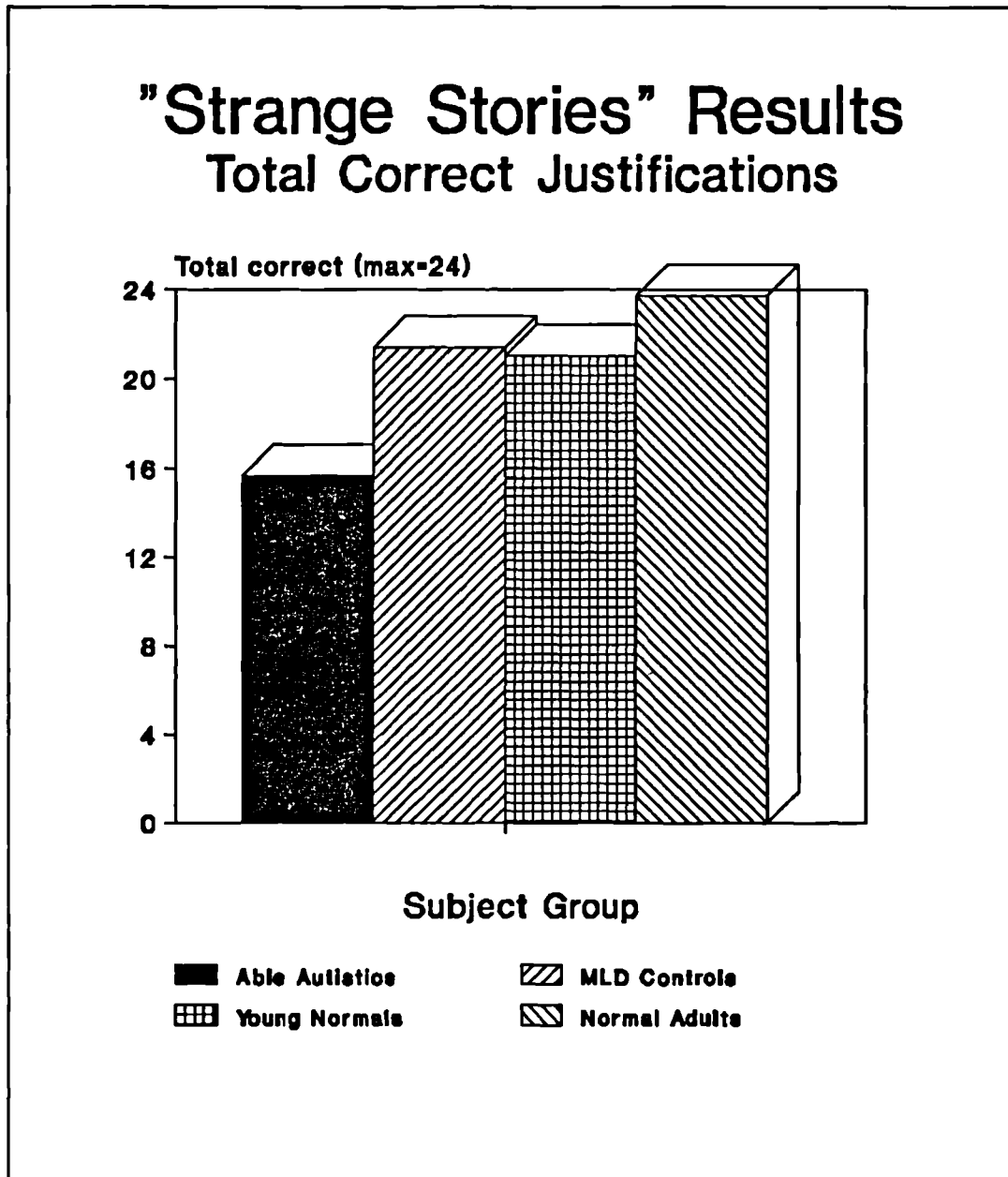


Figure 4.1 Strange Strories results: Total correct justifications

The mean total number of mental state justifications (maximum 24) given by the able autistic group was 15.9 (range 8-23), versus 16.5 by the MLD group (12-22) and 18.2 by the young normals (15-22). Thus the autistic group did not differ in

the tendency to use mental state language in answering the "Why" question, but rather differed only in the appropriateness or accuracy of the mental states attributed.

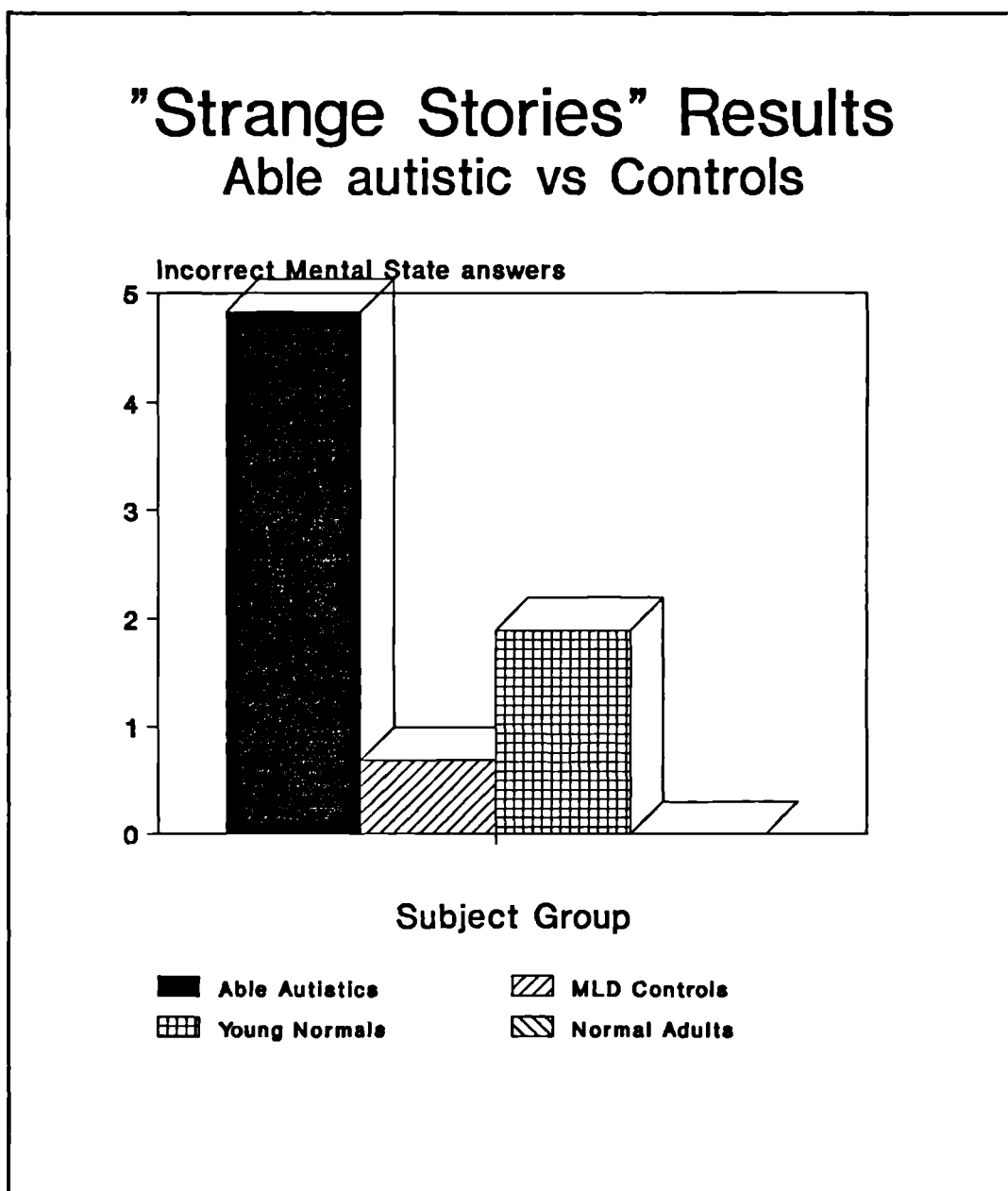


Figure 4.2 Number of incorrect mental state justifications by subject group

The results also show that where there is an acceptable physical state justification (eg. for saying a banana is a phone: "Because it looks like one") the autistic subjects perform as well as the young normals and MLD controls. All three groups differ from the normal adults, who tend not to give physical state justifications,

referring instead to mental states (in the banana example: "She's just pretending its a phone").

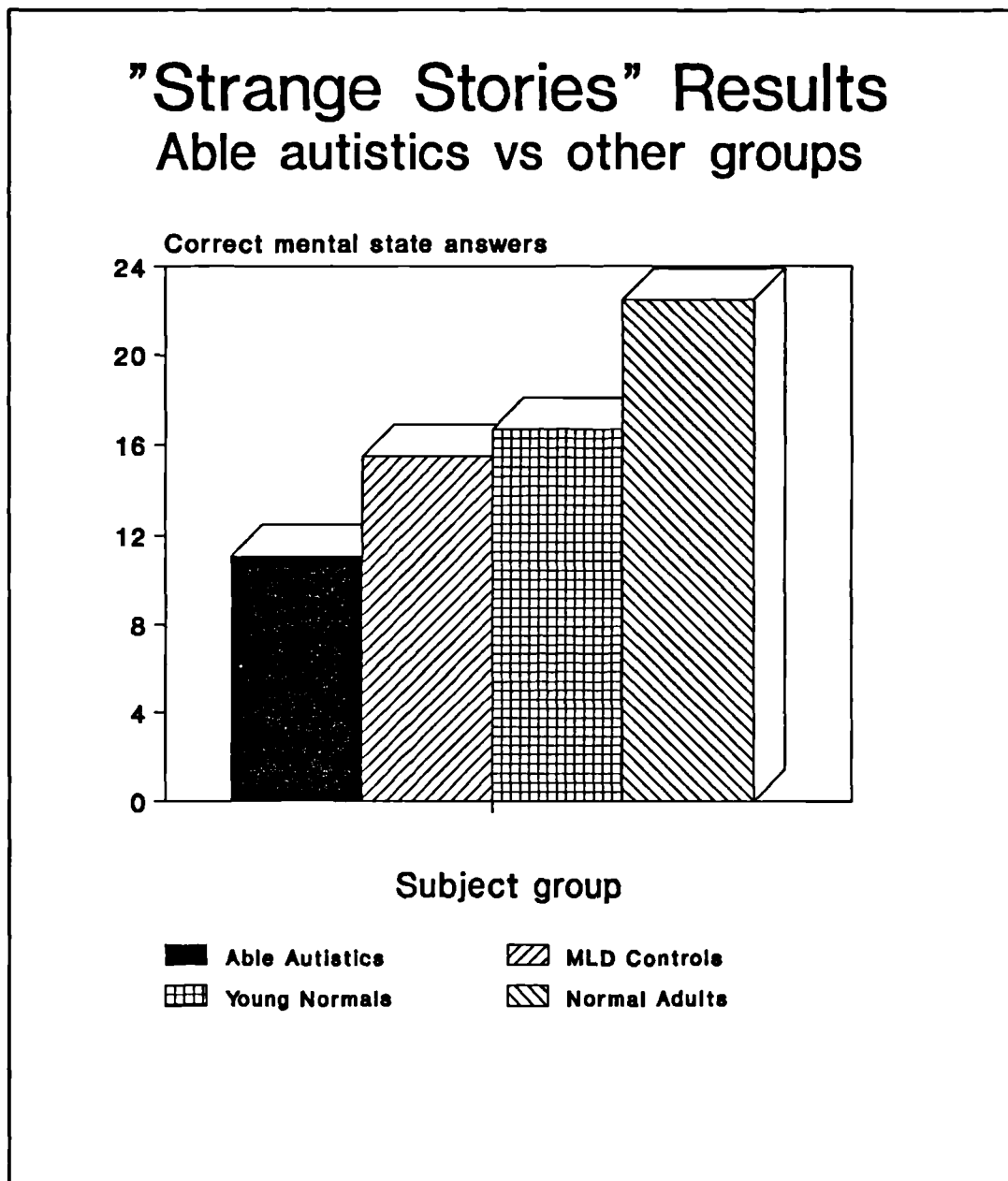


Figure 4.3 Correct mental state answers: able autistics versus controls

The Strange Stories were also intended to explore the validity of the theory of mind battery tests and the successful performance of some of the autistic subjects. The results for the autistic subjects grouped by their performance on the theory of mind battery can be seen in table 4.4 and figure 4.4 below.

Table 4.4

**Results from "Strange Stories"; Autistics grouped by ToM performance
Group means and ranges**

Group	Total Score (Max=24)	Correct justifications		Incorrect justifications	
		Mental	Physical	Mental	Physical
No ToM Autistics	7.5 ^a (6-9)	5.0 (3-7)	2.5 (1-4)	11.0 ^c (8-16)	4.67 ^d (2-9)
1st-order Autistics	12.8 ^a (9-16)	7.7 (3-13)	5.1 (0-9)	6.0 (4-10)	3.0 (0-6)
2nd-order Autistics	20.0 ^a (17-21)	15.3 ^b (11-19)	4.7 (1-7)	3.3 (1-6)	0.5 ^d (0-1)

^a ANOVA, $F(2,14)=66.7$, $p<0.000$; Tukey's test shows that the **total score** of the "no theory of mind" group is significantly less than that of the other two groups ($p<0.01$), and the "second-order theory of mind" group scored significantly higher than "first-order" or "no theory of mind" groups ($p<0.01$).

^b ANOVA, $F(2,14)=19.2$, $p<0.000$; Tukey's test shows that the "second-order theory of mind" autistics gave more **correct mental state justifications** than the other two groups ($p<0.01$).

^c ANOVA, $F(2,14)=10.6$, $p<0.002$; Tukey's test shows that the "no theory of mind" autistics gave more **incorrect mental state justifications** than did the "first-order theory of mind" autistics ($p<0.05$), or "second-order theory of mind" group ($p<0.01$).

^d ANOVA, $F(2,14)=5.6$, $p<0.016$; Tukey's test shows that the "no theory of mind" autistics gave more **incorrect physical state justifications** than "second-order theory of mind" autistics ($p<0.05$).

As can be seen from the ranges in table 4.4, there was little overlap in the total number of correct justifications between the three theory of mind groups. The three groups differed significantly from each other in total score (fig. 4.4), with autistic subjects in the "no theory of mind" group scoring least and those in the "second-order theory of mind" group scoring most. This supports the validity of the theory of mind battery tasks, suggesting that differences in performance on that battery reveal real underlying differences in the ability to attribute mental states correctly

in a variety of tasks. This finding also supports the validity of the 3 autistic subgroups created here.

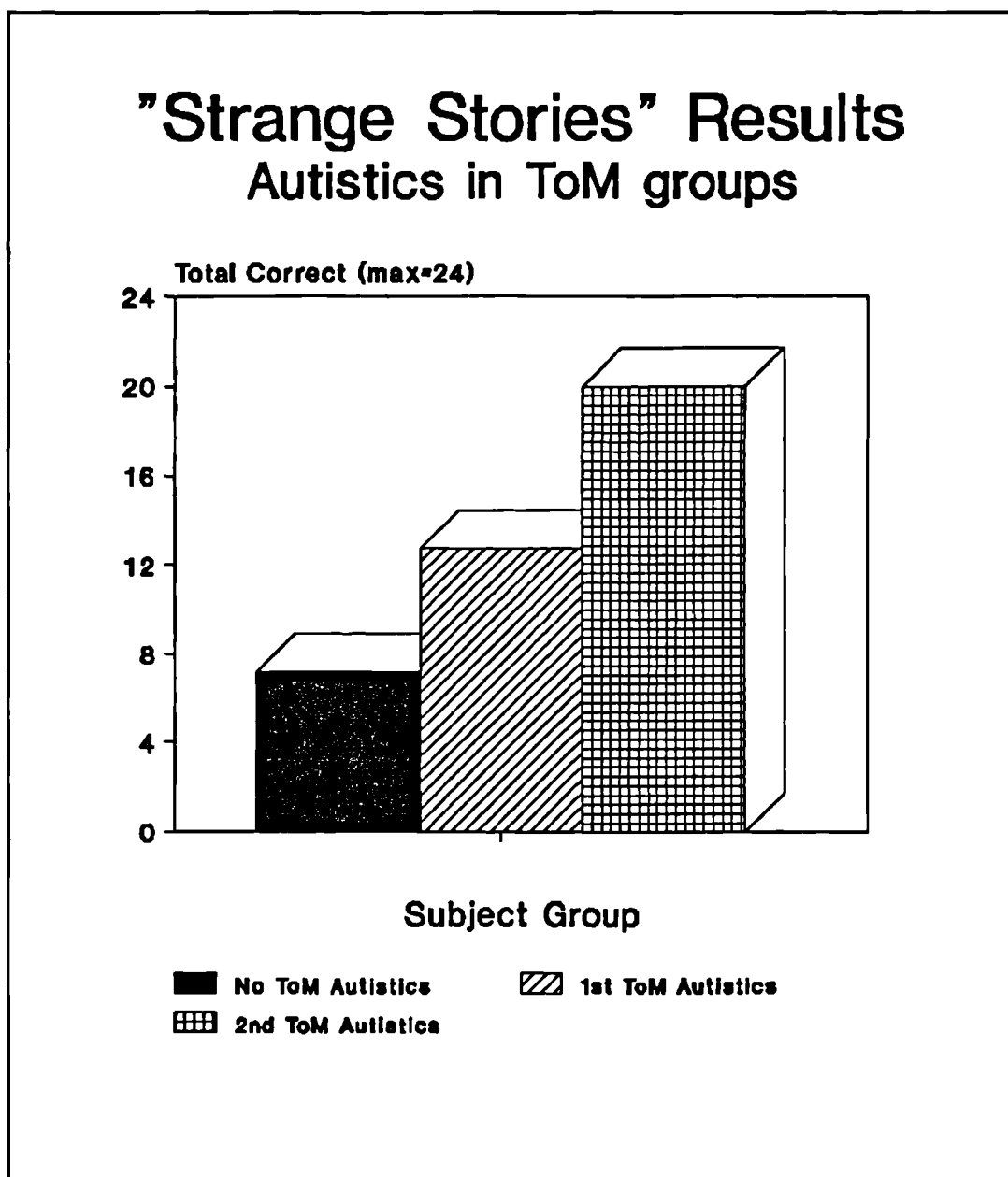


Figure 4.4 Total number of correct justifications; autistics by theory of mind group

While it is possible that the subjects in the "no theory of mind" group performed worse than those who passed either first- or second-order theory of mind tasks simply due to their lower verbal IQ (see also p.99), this explanation appears unlikely in view of the good performance of the MLD controls. The MLD subjects, who match the "no theory of mind" group on verbal IQ, performed significantly

better than this group on the Strange Stories (total score: MLD controls' mean 21.4, range 17-24, versus "no theory of mind" autistics' mean 7.5, range 6-9). Thus high verbal IQ cannot be essential for this task. This suggests that the group differences found may be due to real underlying differences in understanding of mental states, that is theory of mind.

The three groups of autistics were also compared individually with the control groups with one-way ANOVA followed by Tukey's tests. The "no theory of mind" group of autistics was significantly worse than all three control groups: the total correct for this group was significantly less than the MLD, young normal or adult controls (ANOVA $F(3,50)=60.6$, $p<0.000$; Tukey $p<0.01$ for each pairwise comparison). Similarly the "no theory of mind" group gave significantly fewer correct mental state justifications ($F=51.5$, $p<0.000$; Tukey $p<0.01$), and more incorrect mental state justifications than any of the control groups ($F=44.9$, $p<0.000$; Tukey $p<0.01$). The "first-order theory of mind" group of autistics also performed poorly compared with the controls. Their total correct was significantly lower than any of the three control groups (ANOVA $F(3,51)=26.3$, $p<0.000$; Tukey $p<0.01$ for all pairwise comparisons). They also gave fewer correct ($F=34.9$, $p<0.000$; Tukey $p<0.01$) and more incorrect mental state justifications than the controls ($F=20.5$, $p<0.000$; Tukey $p<0.01$).

The autistic group most interesting to compare with the controls was that consisting of subjects who passed the second-order theory of mind tasks in the previous experiment. It had been hoped that the "Strange Stories" might be more naturalistic than the usual theory of mind tasks, and so might reveal the true social handicaps that even this group of subjects appeared to display in everyday life. The results showed some evidence of this. The "second-order theory of mind" group had a significantly lower total correct than the normal adult controls (ANOVA $F(3,51)=4.1$, $p<0.01$; Tukey $p<0.05$). The normal adults also gave significantly more correct mental state justifications than the "second-order theory of mind" autistics ($F=14.6$, $p<0.000$; Tukey $p<0.01$), and than the MLD and young normal controls ($p<0.01$). Lastly, these autistic subjects gave a significantly higher number of incorrect mental state answers than the normal adults and even than the (much lower IQ) MLD controls ($F=7.9$, $p<0.000$; Tukey $p<0.01$). The significance of these

results is discussed below, where the case is made that for these very able autistic subjects normal adults form the most appropriate control group.

The results were also analysed in terms of frequencies. The number of subjects in each group giving incorrect mental state justifications was compared, since this type of answer had proved a discriminative measure in the foregoing analyses. In addition, the battery of stories was decomposed into the twelve story types for this frequency analysis, allowing an exploration of the relative difficulty of the different scenarios described. The frequencies expressed as numbers per group (and as percentages for ease of comparison) can be seen below in table 4.5 and figure 4.5. The normal adults do not appear in table 4.5 since no subject in this group gave an incorrect mental state justification. However, significant differences shown between autistic and young normal and MLD control groups also hold between autistics and normal adults.

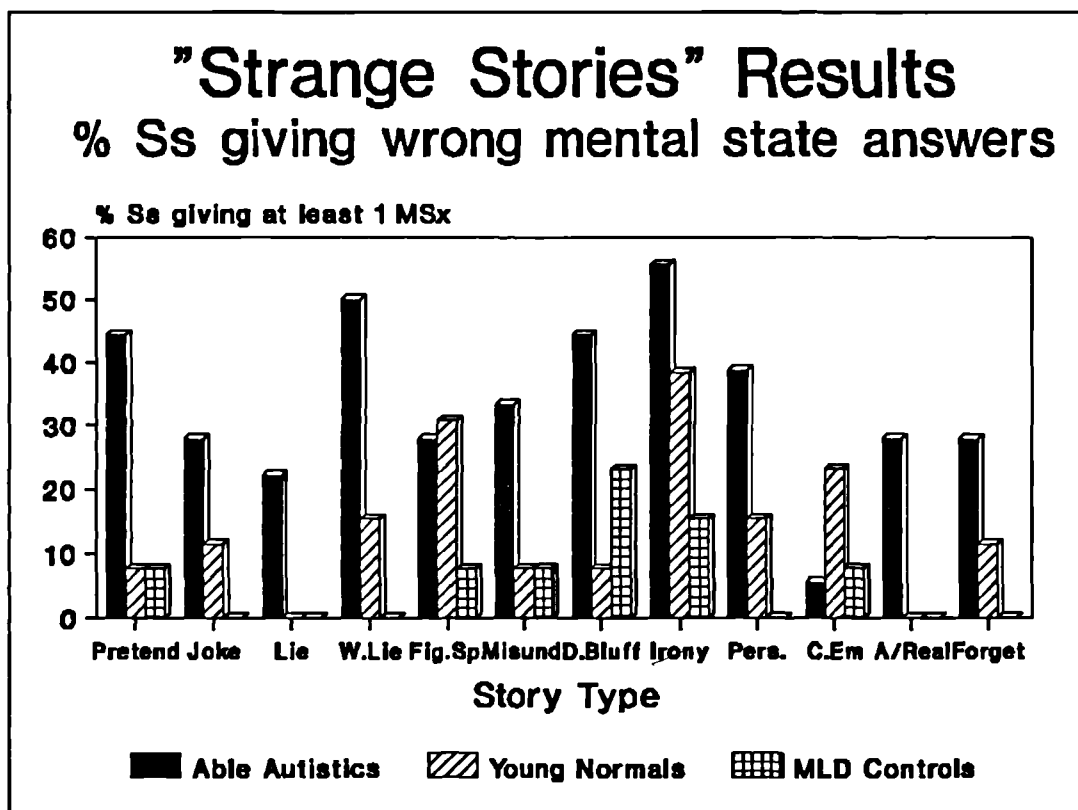


Figure 4.5 Percentage of subjects giving wrong mental state answers, by subject group and story type

Table 4.5

**Numbers of subjects giving at least one incorrect mental state justification
Data by subject group and by story type (percent in brackets)**

Story Type	MLD Controls N=13 N (%)	Normal Children N=26 N (%)	"Able Autistics" N=18 N (%)
Pretend	1 (7.7)	2 (7.7)	8 (44.4) ^a
Joke	0	3 (11.5) ^b	5 (27.8) ^a
Lie	0	0	4 (22.2) ^a
White Lie	0	4 (15.4)	9 (50.0) ^a
Figure of Speech	1 (7.7)	8 (30.8)	5 (27.8)
Misunderstanding	1 (7.7)	2 (7.7)	6 (33.3) ^a
Double Bluff	3 (23.1)	2 (7.7)	8 (44.4) ^a
Sarcasm	2 (15.4)	10 (38.5) ^b	10 (55.6) ^a
Persuasion	0	4 (15.4) ^b	7 (38.9) ^a
Contrary Emotion	1 (7.7)	6 (23.1) ^b	1 (5.6)
Appearance/Reality	0	0	5 (27.8) ^a
Forget	0	3 (11.5) ^b	5 (27.8) ^a

^a Significantly more autistic subjects than young normal and MLD controls make mental state errors, on chi square test and Page's trend test $p < 0.05$ or $p < 0.01$.

^b Significantly more of the young normals than the MLD controls make mental state errors, on chi square and Page's trend test $p < 0.05$ or $p < 0.01$.

Table 4.5 shows that more "able autistic" subjects made mental state errors than any other group - and this was true for 10 of the 12 story types. Only on stories about figures of speech and about contrary emotions did autistic subjects make as few errors as controls. This is interesting in view of the fact that figures of speech may be learnt without any appreciation of mental states, since they are frozen expressions

(but see chapter 6 for why having a theory of mind may nevertheless relate to understanding). It is also intriguing that the autistic subjects were not troubled by the contrary emotion stories.

The numbers of autistic subjects, grouped by performance on the theory of mind battery, who gave at least one incorrect mental state justification can be seen in table 4.6 and figure 4.6 below. The frequencies are also given as percentages to give an impression of how this data compares with that from the control groups (given in table 4.5).

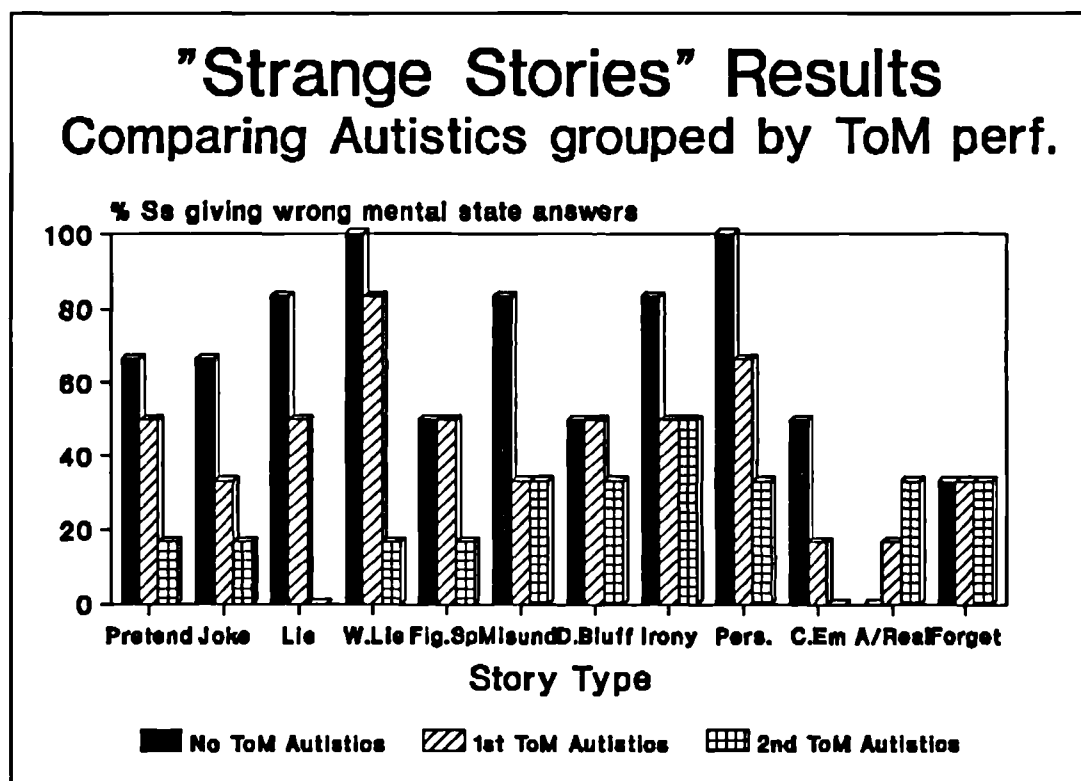


Figure 4.6 Percentage of subjects giving wrong mental state answers; comparing autistic subjects grouped by theory of mind performance

Table 4.6
Numbers (%) of subjects giving at least one incorrect mental state justification
Results for autistic subjects grouped by theory of mind performance

Story Type	Group:	"No ToM" Autistics N=6 N (%)	"1st-order Autistics" N=6 N (%)	"2nd-order Autistics" N=6 N (%)
Pretend		4 (66.7)	3 (50)	1 (16.7)
Joke		4 (66.7) ^a	2 (33.3)	1 (16.7) ^b
Lie		5 (83.3) ^a	3 (50)	0 ^b
White Lie		6 (100)	5 (83.3)	1 (16.7) ^b
Figure of Speech		3 (50)	3 (50)	1 (16.7)
Misunderstanding		5 (83.3)	2 (33.3)	2 (33.3)
Double Bluff		3 (50)	3 (50)	2 (33.3)
Sarcasm		5 (83.3)	3 (50)	3 (50)
Persuasion		6 (100) ^a	4 (66.7)	2 (33.3) ^b
Contrary Emotion		3 (50)	1 (16.7)	0
Appearance/Reality		0	1 (16.7)	2 (33.3)
Forget		2 (33.3)	2 (33.3)	2 (33.3)

^a On chi square and Page's trend test, significantly more subjects in the "no theory of mind" group than in the other two groups made mental state errors, $p < 0.05$ or $p < 0.01$.

^b On chi square and Page's trend test, significantly fewer subjects in the "second-order theory of mind" group than in the other two groups made mental state errors, $p < 0.05$ or $p < 0.01$.

Table 4.6 and figure 4.6 show that 3 of the story types discriminated well between the three sets of autistic subjects grouped by theory of mind performance. On stories concerning joking, lying, and persuasion more of the subjects in the "no theory of mind" group made mental state errors than did subjects in the "first-order theory of mind" group, who in turn were more likely to make such errors than the

"second-order theory of mind" autistics. It is not clear why these stories in particular should show significant differences, and it is probably unwise to draw strong conclusions from such small numbers, but it may be that these stories are at a level of difficulty which best reveals real underlying differences in the three groups' ability to attribute mental states. In contrast, stories about sarcasm, double bluff and so on may be too difficult, and stories about appearance/reality, forgetting and so forth too easy.

Discussion

The battery of "Strange Stories" proved to be useful in discriminating between the control subjects and those autistic subjects who failed all theory of mind tasks. Only one subject from the control groups scored a total correct of less than 17 out of 24 on the stories (this subject was a young normal child who had just turned 8, who scored 11/24). In contrast, autistics in the "no theory of mind" group scored no more than 9/24. Similarly, total score on the stories discriminated well between the three groups of autistic subjects, allocated to groups by their performance on the theory of mind battery. The almost complete lack of overlap between the groups on this measure suggests that the varied and complex materials of the Strange Stories battery tap the same underlying ability as the theory of mind battery, despite their quite different format. This result therefore supports the validity of the theory of mind battery tasks, since understanding of false belief and deception there predicted understanding of such diverse but conceptually connected situations as pretence, joking, persuasion, telling a white lie, and so forth in the "Strange Stories".

A similar picture emerged between the groups in number of **correct mental state justifications** given. Here the control subjects never gave fewer than 12 correct mental state answers (with one exception - the same young normal, who gave only 10 correct mental state answers), while the "no theory of mind" group autistics never gave more than 7, and only one of the autistic subjects in the "first-order theory of mind" group gave more than 10 (subject number 177, gave 13 such answers). By contrast the autistic subjects who passed second-order theory of mind

tasks also performed well on the stories, giving at least 11 correct mental state answers.

In the "no theory of mind" group there was a tendency to give one mental state justification again and again, interspersed with physical state answers. So, for example, subject 172 gave the same response - "she/he's having a joke" - for 15 of the 24 stories. While this response was correct for the joke stories it was highly inappropriate for the lie, white lie, misunderstanding, persuasion and forgetting stories for which it was also given. One 18 year old boy with a full IQ of 85 (subject 173) prefixed 14 of his 24 answers with the verbs "to think" or "know", but evidenced little understanding of the mental states involved; for example "he thinks a lawn mower cut her hair" for the joke story, "she doesn't know he doesn't keep pigs in his room" for the figure of speech story, and "she thought it was a rabbit, and she didn't know she didn't want the book" for the white lie story. A third subject (170) used the answers "she/he made a mistake" and "she/he couldn't make up her/his mind" repetitively and largely inappropriately in response to the stories. This tendency to use a particular mental state justification throughout did not appear to be to do with conditioning in the test situation; it was not the case, for example, that the explanation used was the correct answer to the first story read. In any case, the experimenter's response was always positive, and no differential feedback was given for right versus wrong answers. None of the MLD controls showed this pattern of perseverative responding, and so it is unlikely to represent simply an attempt to generate answers where low ability makes material hard to comprehend. It therefore seems that these subjects came to the test situation equipped with one or two explanations for why people say "puzzling" things. It is possible that these explanations had been told to the subjects in response to questions about particular situations, and that the subjects noted them without understanding the precise nature of the context in which they apply (chapter 7 discusses why autistic subjects may find it hard to perceive such a context). It would be interesting to explore the application of these set explanations, to see whether they would be given in response to questions about actions as well as utterances, about puzzling behaviours caused by physical rather than mental states, and about the behaviour of inanimate as well as human "actors".

On the measures discussed so far the "second-order theory of mind" group of autistics performed indistinguishably from the young normal and MLD controls. It should be remembered, however, that this group of autistics had a mean VIQ of 95 compared to the MLD group's mean VIQ of 56. There was in fact no overlap in the VIQs of these two groups, and one might conclude that since the autistic subjects in this group were all of approximately normal IQ (and only one was under 16 years old) the appropriate control group would be a group of normal adults. Comparison with the normal adults tested here, reveals that the Strange Stories did in fact expose deficits in even this very able group of autistics. The autistic subjects gave significantly fewer correct mental state answers and made significantly more errors in attributing mental states. While every one of the "second-order theory of mind" group gave at least one (and on average 3) incorrect mental state attribution, not one of the normal adults made such a mistake. The errors made by the autistic subjects in the "second-order theory of mind" group were striking; subject 188 said that the mother in the sarcasm story said what she said ("That's what I call politeness!") "not to shock her daughter"; subject 180 explained the utterance in the pretence story ("This banana is a telephone") by saying "she said it to fool her"; subject 183's justification for the double bluff soldier story was "he just wanted to tell the truth", and for the persuasion story he described the threat to drown the kittens as "just a joke". These results suggest that the Strange Stories may be a more sensitive and naturalistic test of theory of mind ability than the relatively artificial and simplified false belief and deception tasks of the theory of mind battery. The results on the stories may more closely reflect the real life difficulties in understanding other minds that even the most able autistic subjects seemed to have. The comparison with the normal adults in this experiment is, however, imperfect, since these adults were students and probably of significantly higher IQ than even the second-order theory of mind autistic subjects. It would therefore be important to compare such able autistic subjects with less intelligent normal adults.

The tendency to give correct physical state answers (eg. "because the dog is big like an elephant", "because the banana looks like a phone") appears to be related to mental age in the non-autistic groups. While the normal adults rarely gave such answers (4 out of the 10 adults gave between 1 and 5 such answers), they were a

regular feature of the performance of the young normal children and the MLD controls. In both these groups every subject gave at least one correct physical state justification, numbers varying between 1 and 10. Most of the autistic subjects also used such justifications, although here this appeared to have less to do with ability, and even the most able autistic subjects (who had IQs in the normal range, and were as old as the normal adults) all gave at least one such answer.

The results for **incorrect physical state answers** are harder to interpret, since this category includes both answers that are factually incorrect about physical aspects of the stories (eg. "the dog broke the vase"), and answers that refer inappropriately to physical events where mental events are the appropriate focus for the justification (eg. "the vase is broken"). This makes it hard to know whether a large number of incorrect physical state justifications reveals a subject's general inability to understand the story events, or their specific difficulty with mental state attribution (leading them to appeal to physical states as explanations for what is said). The results show that normal children and adults seldom gave incorrect physical state justifications, while autistic and MLD subjects gave significantly more, and did not differ from one another in this respect.

Very different processes may, however, underlie the similar scores on this measure in the MLD and autistic groups. In the "first-order theory of mind" group many of the autistic subjects showed striking inventiveness in finding some cause in the physical world to explain the speaker's literally-false utterance; subject 189 explained the utterance in the pretend story about playing ships ("..you're standing in the sea!") by saying that the boys had flooded the kitchen, and explained the white lie about being glad to receive encyclopedias instead of a rabbit as being "because the book was all about rabbits". Subject 176 responded to the figure of speech "a frog in your throat" by saying that the story character had swallowed a frog. A 24-year-old man with a verbal IQ of 100 (subject 196) explained the story about pretending a banana is a telephone by saying that, "some cordless telephones are made to look like fruit".

These responses give an immediate sense of the autistic person's idiosyncratic view of events, and the relative difficulty for them of attributing mental states which

makes constructing an elaborate and unusual physical explanation the preferred or easier (or the only) option. These idiosyncratic responses may also reveal peculiarities in the accessibility of different processing contexts, since they appear to normal communicators to be far more "costly" to process than the correct mental state answer. This issue will be discussed, in relation to Frith's (1989a) theory of a deficit in "central coherence" in autism, in chapter 7.

Striking in the results from the Strange Stories was the fact that the autistic subjects did not use significantly fewer mental state justifications overall than the control groups. This stands in contrast to Tager-Flusberg's (1989) finding that young autistic children use fewer mental state terms in spontaneous communication than MLU-matched Down syndrome subjects. What distinguished the autistic subjects in the present study was not a failure to use mental state terms but a failure to use the appropriate mental state terms in response to the Strange Stories. The fact that autistic people appear to recognise that these stories require answers in the realm of mental state language is itself surprising and intriguing. It may be that these relatively able autistic subjects have learnt that there is a class of words which apply to events which are (for them) "puzzling", and where literal meaning of a speaker's utterance does not make sense. It would be interesting to explore the class of situations to which autistic people apply mental state terms, as suggested above (p.118) for the repetitive set explanations used by the autistic subjects in the "no theory of mind" group.

The results from the "Strange Stories", then, suggest that there are real underlying differences between the autistic subjects in the "no", "first-order" and "second-order theory of mind" groups. This supports the validity of the tasks in the theory of mind battery, indicating that they may measure an underlying competence in attributing mental states that is also tested by the "Strange Stories". In addition the stories seem to have revealed impairments in social understanding in even the most able autistics, who passed all the tasks in the theory of mind battery. This may be because some of the stories were actually understood by normal subjects at a third-order theory of mind level (eg. double bluff; he knows they think he will lie). Alternatively, it may be that the slightly more naturalistic format of the stories, and the absence of test questions drawing attention to salient elements (which are a

feature of the theory of mind battery tasks), may reveal the difficulties even the most able autistic individuals appear to have in **applying** what social knowledge they may have, in everyday life. While chapters 5 and 6 go on to explore the nature of these subjects' success on experimental tasks, chapters 7 and 8 suggest one possible reason for their failure in real life "tests" of theory of mind in terms of a failure of "central coherence".

Chapter 5

Theory of Mind and Relevance Theory

Sperber and Wilson's Relevance theory makes explicit the role of the comprehension of intentions in human communication. This makes Relevance theory a promising framework for a deeper understanding of the autistic communication handicap. It may allow us a clearer insight into the baffling variation in degree of communication problems, from the mute autistic child, to those able and very verbal adults who increasingly receive the label "Asperger's syndrome". In turn, a fuller understanding of the autistic communication handicap in its mildest (but still characteristic) form will have implications for our definitions of Asperger syndrome, since relatively good language is perhaps the only unanimously agreed distinguishing feature of this group (see chapter 2).

In this chapter, some of the premises and conclusions of Relevance theory are outlined, with suggestions at each stage as to the possible breakdown of normal functioning in autism. Here the breakdowns which might result from a deficit in metarepresentation, and hence in theory of mind, are considered (all references are to Sperber and Wilson, 1986, unless otherwise specified). In chapter 7, Relevance theory will again be discussed, in relation to the suggestion of a deficit in central coherence (Frith, 1989a).

Cognitive Economy: The problem of optimal allocation of central processing resources

For any device with limited information processing resources, it is obviously important that these resources be deployed as efficiently as possible. This leads to the first major premise of Relevance theory, that our attention automatically turns to what seems relevant in the environment. "Relevant" here means capable

of yielding large cognitive effects relative to small cognitive effort. New but unconnected information is seldom relevant, since it can only be processed as isolated bits and pieces, and has few implications processed in the unrelated context of past information. New but related information, on the other hand, may have important contextual effects, when processed in the context of old premises. As Sperber and Wilson say, "the selection of a particular context is determined by the search for relevance...", and since some contexts are more easily accessed at any one time than others, and hence are less costly in terms of processing effort, the first available context that produces sufficient contextual effects to meet the demands of relevance will be used. Since the effort to access any particular context depends on the organisation of memory, the importance of this organisation in the assessment of relevance is clear. In chapter 7 I will discuss the possibility that autistic subjects may be idiosyncratic in their memory organisation and hence in their calculation of what is relevant.

To Communicate is to Claim the Hearer's Attention

This second premise makes clear the implications of these general cognitive principles for communication. These two premises together lead to the idea that communicated information comes with a guarantee of relevance. This is Sperber and Wilson's "Principle of Relevance"; that every act of ostensive communication (that is, behaviour which makes manifest the communicator's intention to convey something) communicates the presumption of its own optimal relevance. An utterance is optimally relevant if the set of assumptions which the speaker intends to make manifest is relevant enough to justify the hearer's effort in processing the ostensive stimulus, and if that stimulus is the most relevant the speaker could have used to communicate those assumptions. The principle of relevance guides the hearer in his choice of processing context, and the speaker in his choice of words, so that the first available processing context yielding an adequate range of effects is usually taken as that intended by the speaker. For example, after a conversation about pet cats and dogs, the speaker who uses the phrase, "Henry had a big cat", can be assumed to mean a large domestic cat - if he had meant to communicate

that Henry had a lion or tiger he should have said so - while in a conversation about big game hunting the most accessible interpretation might be reversed.

In Autism?

It is a common observation that autistic people seem to miss what we would regard as salient in a situation, and pay close attention to what seems to us irrelevant (eg. Wing, 1976). This is reflected in experimental findings also; for example, Rincover and Koegel (1975) found that, in training, autistic children tended to learn responses to irrelevant details of the teaching situation such as the teacher's dress or the classroom they were in, which severely limited the generalisation of learnt responses. Chapter 7 will suggest some possible reasons for the calculation of relevance to be peculiar in autistic subjects. Here, where discussion of relevance is limited to its relation to theory of mind, our prediction about attention in autism is narrower. For reasons that will become clear, the prediction at this stage would be that autistic subjects show abnormal patterns of attention **only** where the normal pattern of attention favours ostensive over non-ostensive stimuli.

Communication versus Language

Sperber and Wilson stress an important fact about communication; that language and communication are very different and logically distinct things. A language is a grammar-governed representational system, and as such tends to be a necessary prerequisite for most cognitive activities: "Any organism with the ability to draw inferences must have a representational system where formulas stand in both syntactic and semantic relations to each other" (p.172). While it is not necessary to use a language to communicate, for example gestures can be used, communicating devices must possess internal languages. Not only this, but "In the case of ostensive-inferential communication, this internal language must be rich enough to represent the intentions of other organisms, and to allow for complex inferential processes" (p.172, my emphasis).

In Autism?

There is less wrong with autistic language than with its usage (Tager-Flusberg, 1981). In much of what able autistic people say it is hard to find anything formally wrong, rather the listener is left with an overall impression of oddness (Happé, 1991). While it is true that some autistic people never develop language, it is more striking that even those who do, still somehow fail to communicate fully (Baltaxe, 1977; Schopler & Mesibov, 1985). At its extreme, this presents as those cases of hyperlexia where language seems far in advance of communication (Frith & Snowling, 1983; Snowling & Frith, 1986).

While there is little work looking directly at the inferential abilities of autistic individuals, it seems clear from the good performance found by Baron-Cohen, Leslie and Frith (1986), using mechanical and behavioural story sequencing tasks, that autistic children can reason and infer (at least outside the domain of mental states). It therefore seems clear that they do possess an internal language. However, it is doubtful that this language is rich enough to fulfil Sperber and Wilson's criteria for an internal language able to support ostensive-inferential communication. If such a language must be able to represent others' intentions, then it seems it must include what Leslie has termed metarepresentation (cf. chapter 1). His hypothesis, that autistic people have a system of primary representation but lack the more sophisticated secondary or metarepresentational ability, then, makes sense of the intuition that autistic people do possess an internal language, but one too limited perhaps to allow for full ostensive-inferential communication.

Two Ways to Communicate: Coding versus Inference

Another important distinction that Sperber and Wilson draw, is between two possible ways of communicating. Firstly, one can communicate in the way that Morse code operators do - by a system of encoding and decoding messages. This seems to be what happens in transforming the speech stream into the linguistic meaning of the spoken sentence, occurring at a low level in specialised peripheral modules. But normal communication does not end there, as is clear from our ready comprehension of irony, metaphor, and figures of speech, as well as cases of

ordinary implicature. Also clear from the fact that we can only recognise and appreciate these modes of speaking in context, is the point that what goes on beyond decoding is a central, unspecialized inferential process (see chapter 7 for more on this).

In Autism?

Coded communication would appear to approximate well to the sort of simple, instrumental use of words and signs seen in many autistic individuals (Paul, 1987). For example, Baron-Cohen (1989b) found that autistic subjects were competent at using and understanding protoimperative pointing, but failed to employ or comprehend protodeclarative pointing. While the former has a fixed meaning (something like, "give me the thing I point to"), and hence can be employed like a code, the latter has flexible meaning which depends on the context, since it is merely a clue to the actor's intention. Autistic use of spoken language would appear to be instrumental in most cases (Fay & Schuler, 1980) - autistic people learn labels for objects and use these names as single word requests. The object name would appear to become a code with a fixed meaning in such cases (something like "apple" = "give me apple"), rather than a label for some more abstract representation of the object, which could then be used more flexibly (eg. to point out the apple for general admiration, without the aim of getting it).

It is interesting to note the similarity between this simple instrumental use of language seen in most autistic subjects and the degree of language competence that can be taught to apes (Cheney & Seyfarth, 1990, have reviewed work on communication and intentionality in monkeys and apes, in the field and the lab). Terrace (1979) has suggested that the great gulf that separates even the most successful efforts of chimps who learn sign languages from human communicative competence, is that the ape's use of language remains purely acquisitive. In other words, apes, like the majority of autistic people, master only the protoimperative and never the protodeclarative use of language. It seems likely that this may be more than a surface resemblance; it may well be that both groups fail to acquire communicative competence beyond the use of codes because of their inability to represent intentions (Happé & Frith, in press).

Inferential Communication and the Recognition of Intent

The other way to communicate, apart from by using a code, is by providing evidence for an intended inference about your informative intention - that is, by inferential communication. Such communication is inferential in the sense that the audience infers the communicator's intentions from evidence provided for this purpose (eg. A asks how B is, and B does a cartwheel in reply: there is no code to tell A what this means, but he infers that B means he is quite well). Such inference is thought to fill the gap left after the decoding process of comprehension. Inferential processes operate on the output of the specialised decoding modules, to derive from the linguistic meaning of the sentence the speaker's intention in uttering it. A communicator intentionally engaging in inferential communication produces an ostensive stimulus with two intentions; first, the "informative intention" to make mutually manifest the information X, and second, the "communicative intention" to inform the hearer of his intention to make X mutually manifest. Thus the communicative intention is itself a second-order informative intention. The normal process of ostensive-inferential communication relies upon the capacity to recognise at least the informative intention. This is because it is knowing that X was deliberately and intentionally communicated, that allows the listener to use the guarantee of relevance to disambiguate the speaker's intention in using the utterance. There are also some cases of communication where the second-order intention, the communicative intention, must be recognised - for example in phatic speech which achieves relevance only by making manifest the intention to communicate. Much of normal daily "small-talk" is like this; when we say "Nice day, isn't it" and so on we are not making manifest any information except our intention to take part in a communicative exchange with the hearer.

In Autism?

Research into the autistic child's theory of mind (Baron-Cohen, Leslie and Frith, 1985) has found a severe impairment in most autistic subjects' ability to comprehend another person's false belief (see chapter 1). Leslie (1987, 1988), in his metarepresentational conjecture, has shown how representing such mental states - along with pretence - requires a more advanced form of representation (the

representation of propositional attitudes, ie. the representation of representations). This level of secondary or metarepresentation seems to be lacking in the autistic person's processing of social situations. Thus most autistic people are handicapped in the understanding of others' mental states. For such people, inferential communication - which requires the recognition of intentions - may be an unattainable goal. This would leave them, perhaps, with only coded communication - as detailed above.

Without the ability to recognise the intention to inform, many autistic people may be unable to recognise ostensive behaviour (behaviour which makes manifest an intention to inform, eg. showing) - or to distinguish it from nonostensive behaviour. This might explain the apparent "deafness" and delay in language learning seen in many autistic children - who do not orient to speech, but seem to treat it as part of the background noise (Kanner, 1943; Paul, 1987). Normal children, by contrast, pay attention to speech sounds as specially salient stimuli produced with intention towards the hearer. Recent work by Klin (1991) demonstrated this often anecdotally reported difference, experimentally. He tested the listening preferences of twelve autistic children and eight mentally retarded CA- and MA-matched controls, along with ten normal MA-matched controls. Subjects could choose to listen to a recording of their mother's speech or a recording of a noisy canteen (where there was no comprehensible speech stream). The autistic children showed no preference, or preferred the canteen noise, while the controls all chose (on more than half the occasions) to listen to their mother's speech. Such findings are striking, although as usual the late age of diagnosis hampers the discovery of causal directions or priority of deficits - the autistic subjects were aged 49 to 79 months.

If a failure to represent intentions underlies the autistic communication handicap, what of the minority of autistic children tested who do pass first-order false belief tasks (understanding that someone can have a false belief about the world). While the possibility remains that these subjects are using some heuristic but do not have a theory of mind, it seems likely from the results in chapter 3 that at least some autistic people do develop metarepresentational ability sufficient to comprehend other's first-order mental states (including intentions). These individuals still show peculiarities of expression, and these require explanation.

It may be that some of this able minority do understand first-order intentions, but not second-order intentions - that is, intentions about others' mental states rather than about the world (Baron-Cohen, 1989a). This would make them capable of recognising the speaker's informative intention, but not their communicative intention - which as we have seen is itself a second-order intention. This inability would prevent them from mastering the small-talk which is so common in normal social life, and which is only relevant because it conveys the second-order communicative intention. In this respect, the theory put forward here is interestingly different from other analyses of the role of theory of mind in communication. For example, Tager-Flusberg (in press), suggests that it is the autistic inability to use language to transmit information, which is the paradigmatic case of communication breakdown: "autistic children do not seem to develop the understanding that conversations ought to entail the exchange of information. This appears to be at the heart of what makes communication with autistic people so difficult". By contrast, the analysis presented here suggests that the quintessential case of failure of communication due to lack of theory of mind will occur precisely where nothing but the intention to communicate is conveyed. In addition to this failure with phatic speech, an inability to represent thoughts about thoughts would preclude certain other sorts of speech acts - utterances which, according to Sperber and Wilson, are interpretations of a speaker's thought about an attributed or desirable thought (see below).

Recognising Intentions allows the same sentence to convey different meanings

There are many situations in which the speaker aiming at optimal relevance may not give a literal interpretation of her thoughts. This is the case, for example, where pedantry is avoided - if someone asks you how much you earn, you will in most cases not give the precise figure, but a rounded estimate that is less costly for the hearer to process (in the absence, that is, of any indication of need for greater precision which would justify the greater processing costs). Sperber and Wilson claim that there is no discontinuity between such "loose" uses and figurative speech.

Both occur simply as a result of the speaker's search for relevance, which leads her to adopt a more or less literal interpretation of her thought.

It is because in communication we are concerned with the speaker's intentions, that - as Sperber and Wilson put it - "the same piece of evidence can be used, on different occasions, to make manifest different assumptions, even mutually inconsistent assumptions, as long as it makes manifest the intention behind the ostention" (p.52). The initial message we derive from the speaker saying, "The weather is lovely" - for example - is not <The weather is lovely>, but rather <The speaker is saying that "The weather is lovely">. Thus the speaker's attitude to what she is saying, her intention in saying it, becomes of vital importance. Why is the speaker saying this? If the weather is obviously horrible then the search for relevance may lead the hearer to understand the speaker as being sarcastic. Thus the same surface form may make manifest different assumptions, according to the different communicative intent underlying its utterance. And, as before, it is the criterion of consistency with the principle of relevance that allows us to decide which assumptions are warranted.

Metaphorical expression, then, is just another way of striving for relevance in one's communication. Therefore, "whatever abilities and procedures are needed to understand it (metaphorical expression) are independently needed for the interpretation of quite ordinary, nonfigurative utterances" (p.238). As above, in metaphors the logical form of the utterance is not an explicature (i.e. not part of the intended interpretation). So, as with the weather example, the explicature the hearer derives from the utterance, "This room is a pig-sty" is not <This room is a pig-sty>, but rather <The speaker is saying that "This room is a pig-sty">. (Note the similarity between this form and Leslie's form for metarepresentations; Agent-informational relation-"expression", for example, I PRETEND "this empty cup contains water").

In Autism?

If, as has been suggested above, even able autistic people are communicating without the guarantee of relevance (due to an inability to represent intentions) then communication should be most likely to break down for them where the speaker's

attitude must be taken into account in modifying the literal meaning of the sentence used. Those autistic people who lack first-order theory of mind may be operating with the propositional form of the utterance as the explicature they derive in communication - that is, they will be doing precisely what it has just been claimed normal communicators using ostention do not do.

It is widely reported (Tantam, 1991; Happé, 1991) that even the most verbally able autistic people fail to understand nonliteral speech such as sarcasm, joking, and metaphorical expressions. From Sperber and Wilson's theory it follows that these autistic people must also be peculiar in their understanding of literal, nonfigurative utterances. This is likely in view of the common finding that able autistic speakers are inappropriately pedantic in their communication. Szatmari, Bartolucci, Bremner, Bond and Rich (1989), for example, found that 60% of their sample of able autistic adults showed "overly formal speech". Similarly, even able autistic people seem to fail to recognise the connotations behind words - the attitudes people have to the words they use, or the intentions behind their choice of word (Frith, 1989b; Happé, 1991). Without the principle of relevance to guide them the autistic person may fall back on a literal interpretation of all utterances. So when someone says, "The weather is lovely" the autistic person derives the explicature <The weather is lovely>. This may serve well enough to get by when the speaker is speaking literally, but the autistic person must be baffled by ironic or figurative usage - and also, perhaps, where the speaker is simply mistaken, or is lying. A highly intelligent person with autism, may learn to recognise situations where people "do not mean what they say" - working on simple rules such as:

literally false or puzzling speech + smile = joke

literally false or puzzling speech + frown = sarcasm

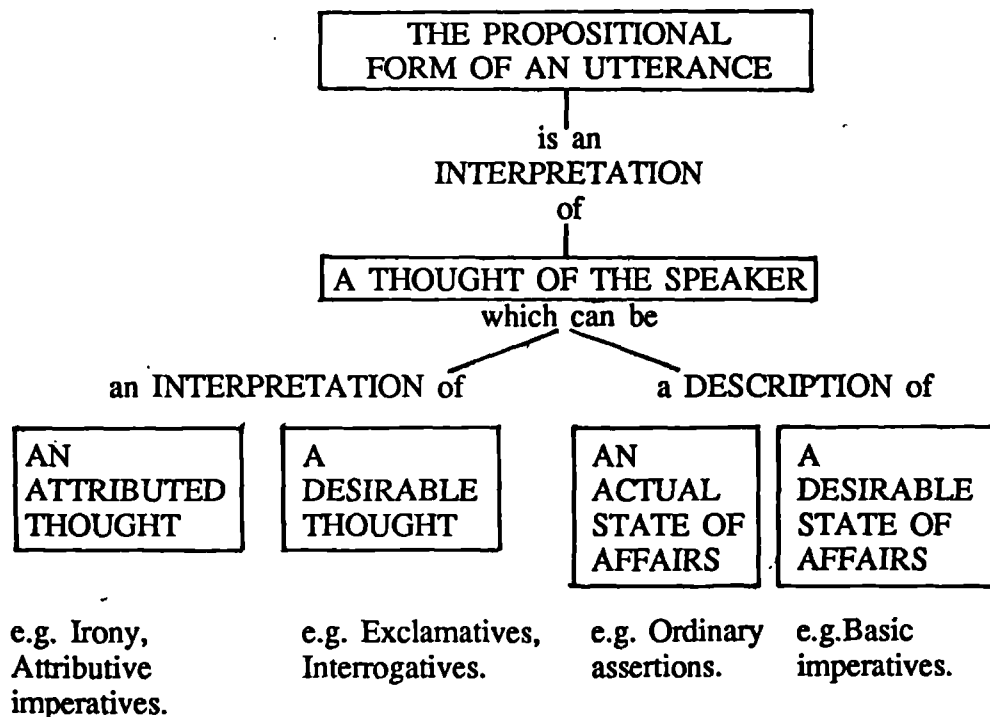
But without the principle of relevance to guide them, the transparency of intentions that allows humans to use language in a truly flexible way, is not open to autistic communicators. In the face of the puzzle that our ostensive communication must pose them, they may have no choice but to adopt a rigid interpretation - a default value of the propositional form of the utterance - in place of our shifting and mercurial intentions.

Interpretive and Descriptive Representations

Sperber and Wilson claim that any representation with a propositional form (e.g. an utterance) can represent things in two ways: "It can represent some state of affairs in virtue of its propositional form being true of that state of affairs; in this case...the representation is a **description**... Or it can represent some other representation which also has a propositional form - a thought for instance - in virtue of the resemblance between the two propositional forms...here the first representation is an **interpretation** of the second one..." (p.228, my emphasis). On a fundamental level, then, every spontaneous utterance is an interpretive expression of a thought of the speaker. Figure 5.1, from Sperber and Wilson (p.232), shows the two sorts of representational relations at play in various types of speech act, plus some examples of the types of utterance that might fall into each category.

Figure 5.1

Possible interpretive and descriptive relations between the propositional form of an utterance, the speaker's thought, and what that thought represents:



According to figure 5.1, some types of utterance are interpretive representations of interpretive representations of states of affairs. It is tempting to equate Sperber and Wilson's two types of representation with Leslie's (1987) representation - metarepresentation distinction. Doing this leads to some interesting predictions. If "interpretations" above are metarepresentations, and "descriptions" are primary representations, then every utterance is understood as a metarepresentation - since an utterance is "an interpretive expression of a thought of the speaker's", and the hearer makes "an interpretive assumption about the speaker's informative intention" (p.230). As such, the implication is that without a theory of mind, autistic communication never works like normal communication - and perhaps only succeeds by assuming a strictly literal expression of the meaning, where the explicature derived is simply the propositional form of the utterance. So in the diagram above the propositional form of the utterance will always be taken as a **literal** interpretation of the speaker's thought. In other words this parameter will be fixed in autistic communication, whereas in normal communication the interpretation can be more or less literal (allowing for loose usage, where the speaker is not committing herself to all the implicatures of her expression).

Figure 5.1 above also leads us to more specific predictions. If interpretation is metarepresentation, then anything on the right hand branch of the diagram requires first-order metarepresentations, and anything on the left hand branch of the diagram requires second-order metarepresentations (since the utterance here is an interpretation of a thought which is itself an interpretation of an attributed thought). So the prediction would follow that an autistic person who proves unable to process second-order metarepresentations (e.g. second-order false beliefs), would also be incapable of using properly or understanding normally such speech acts as attributive imperatives, irony, interrogatives, and exclamatives - since all these lie under the left hand branch of the diagram. (Note, however, that interrogatives and exclamatives are generally marked grammatically in English: where there is an invariant linguistic form to mark an intention, able autistic people may manage deceptively well). Anyone who has first-order theory of mind should be able to operate with ordinary assertions and imperatives. These very specific predictions are worth testing, since they suggest some non-intuitive communication handicaps that might follow from impairment in metarepresentational capacity. An

encouraging start is the finding by Winner and Leekam (1991) that in a group of 63 normal children (mean CA 5:5) recognition of irony relies upon the ability to process the speaker's second-order metarepresentations (what he wants hearer to believe).

Before stating the predictions which follow from the analysis above, and which were tested in the experiments reported in chapter 6, it might be useful to summarise the deficits suggested so far.

The possible points of breakdown in autistic relevance

We have suggested two distinct places in the working of relevance in communication, where autistic people might fail. It is plausible that this gradation of possible deficits may represent a way of understanding the great variation in the severity of communication handicaps seen within the autistic continuum.

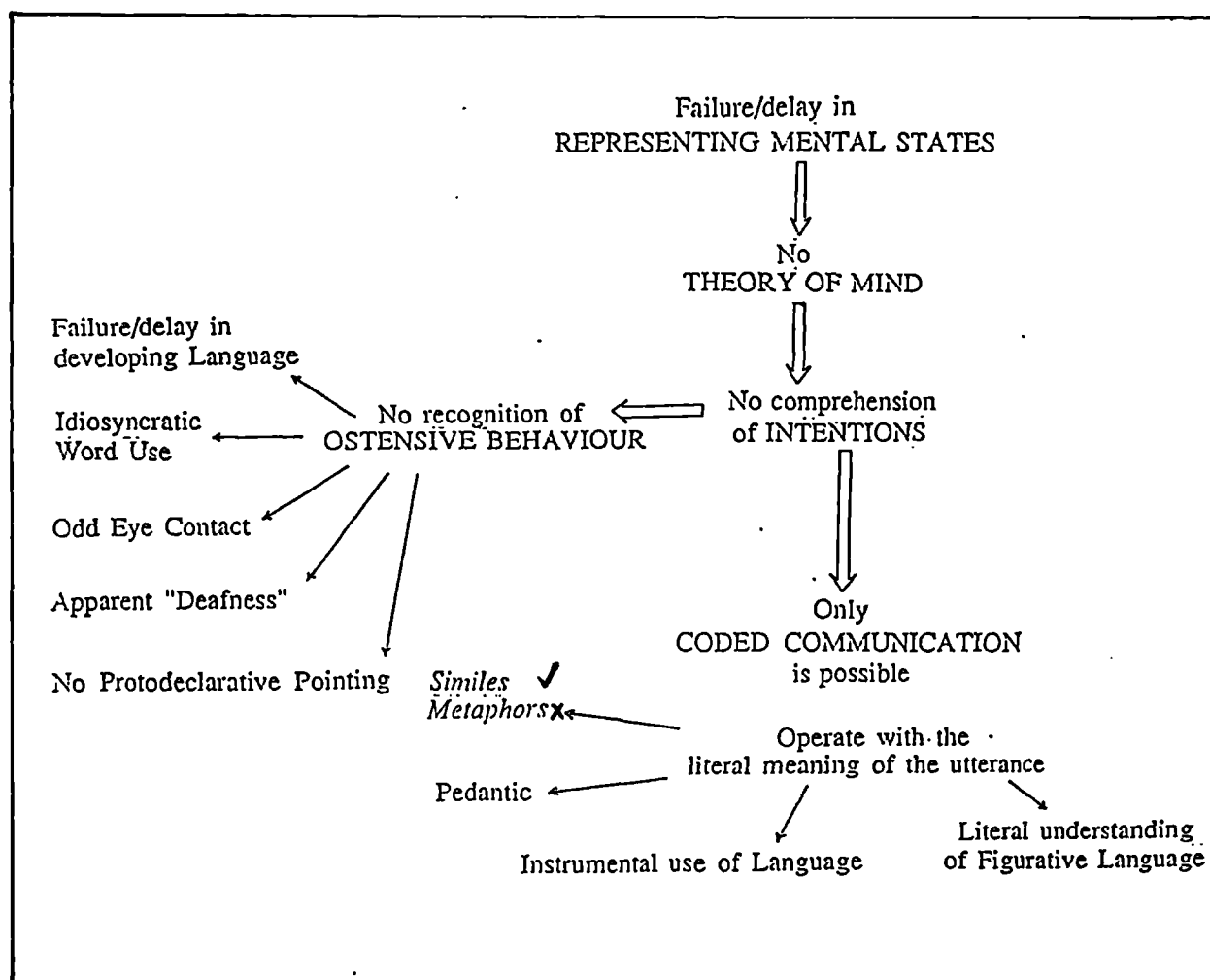
The possible points for the breakdown of relevance in autism can be summarised as follows:

- a) Inferential communication requires comprehension of intentions, so autistic subjects lacking a theory of mind would be barred from proper use of this mode of communication - perhaps leaving them with coded communication alone.
- b) Some forms of speech act may also require the ability to represent thoughts about thoughts. Phatic communication, for example, probably requires recognition of speaker's communicative intention. In addition, lack of second-order metarepresentations may lead to a distinct set of impairments involving utterances which are "interpretations of interpretations" (see fig.5.1).

These possible sites of breakdown are given in descending order of the severity of their imagined outcomes, and although they deal explicitly with understanding,

These possible sites of breakdown are given in descending order of the severity of their imagined outcomes, and although they deal explicitly with understanding, parallel impairments would be expected in production. The causal model in figure 5.2 shows the impairments in theory of mind and its predicted effects on cognition and behaviour (filled arrows signal behavioural manifestations).

Figure 5.2 A causal model of the effects on communication of an impairment in representing mental states



Predictions from Relevance Theory; Simile, Metaphor and Irony

According to Relevance theory, similes can be understood at a purely literal level - saying, "He was like a lion" is no different from saying, "He was like his father". In both cases the hearer is set the task of deciding in what respect there is a similarity. The prediction is, therefore, that even autistic speakers who lack a theory of mind should be capable of using and understanding similes - since a literal interpretation will suffice.

Metaphor, on the other hand, requires some understanding of intentions. In a metaphor the propositional form of the utterance is a more or less loose interpretation of the speaker's thought. Therefore metaphors cannot be fully understood or properly used without a first-order theory of mind - using a default value of literalness will not work. A parallel can be drawn with false belief tests, which necessitate the representation of mental states (as representations) - since in the false case the representation and the situation it represents (eg. the location of the marble) are crucially different. Just as in the false belief situation (but not the true belief situation) the actor's mental state (belief) is crucial and reality alone is no guide to action, so in metaphor (but not simile) the speaker's mental state (intention) is vital, and working with "reality" in the form of the literal meaning of the utterance is not sufficient for comprehension.

Lastly, irony is more demanding still, requiring as it does an understanding of second-order metarepresentation (a thought about an attributed thought). Sperber and Wilson (1986, 1981) consider ironic utterances to be quoting or referring to an attributed thought. When we exclaim, "Well, that's very clever isn't it!", we are mentioning a possible thought and expressing our attitude to it - an attitude of mockery.

Relevance theory, then, can lead us to make some nontrivial and nonintuitive predictions about autistic language use - and, with theory of mind explanations of autism, may help us to understand many of the features of even the most able autistic person's communication.

Conclusions

In this chapter, Relevance theory was presented as a framework for understanding the specific communicative impairment found in autistic people of all ability levels. This theory helps us to understand the autistic communication handicap by showing how a theory of mind, and specifically the ability to handle metarepresentations such as intentions, may be vital to the full ostensive-inferential communication that we as human beings enjoy. In Sperber and Wilson's words: "Communication exploits the well-known ability of humans to attribute intentions to each other". Relevance theory, therefore, allows us to reason from the now well-known work showing a deficit in autistic subjects' theory of mind (Baron-Cohen et al, 1986), to the well-documented autistic communication handicap (Frith, 1989b; Paul, 1987; Schopler & Mesibov, 1985). It goes further than this, too, in relating degree of metarepresentational capacity to degree of communication ability in a quite specific way. The application of Relevance theory to autism, therefore, both generates testable predictions about the nature of the autistic communication handicap, and leads to a possible method of testing Relevance theory itself. Sperber and Wilson have regretted the fact that, "the view developed in "Relevance" is very speculative and, as it stands, too general to determine...specific experimental tests". Autistic communication, then, may serve as a valuable test-case for Relevance theory.

Lastly, relating the autistic person's social and communication problems more directly, via theory of mind and Relevance, may have important implications for our definitions of Asperger's syndrome as a diagnostic entity. Good expressive language is one of the few universally agreed criteria for saying that an autistic person has Asperger's syndrome (see chapter 2). If this proves to be more than a good vocabulary and a fully developed grammar - that is if these people have better communication than most autistic people - it may be that we can begin to be more specific about what we mean by "able autistic" in this context. In other words, it appears from what has been argued above that communication will be good when, and only when, theory of mind is relatively good. So the group of able autistic people defined by good communication may also be those who are able socially.

We may want to distinguish this "able" group from another "able" group whose skills are shown in nonverbal intelligence tests, and who - we would predict - would not show comparably good social adjustment. The label "Asperger syndrome" may be useful, then, to delineate those autistic people who are able in terms of communication and social skills - as opposed to those who have special skills or simply a high performance IQ. If communication and social skills co-vary due to a common reliance on the ability to represent mental states, labelling this group separately on the basis of these behavioural features may have more validity.

As a last thought, it is interesting to note that this analysis sheds new light on two of the features of development that have been pin-pointed as being indicators of a good prognosis. Researchers since Kanner have found that acquisition of communicative language by the age of five years bodes well for the autistic child's future development (Knobloch & Pasamanick, 1975). In addition, Kanner (1973) writes of his most successful autistic patients, that "unlike most other autistic children, they became uneasily aware of their peculiarities and began to make a conscious effort to do something about them" (p.209). This suggests that those children who became relatively high-functioning adults, were distinguished by a sense of self-awareness - which surely can be seen as the emergence of some degree of theory of mind (since metarepresentations are needed to think about one's own mental states, just as they are to reflect upon someone's else's thoughts). Good communication and the emergence of theory of mind, then, appear to be indicators of a good prognosis, and their co-occurrence may be far from coincidental.

Chapter 6

Relevance and Communication Tasks

In chapter 5, Relevance theory was suggested as a framework for making clear the role of understanding intentions in communication. In this chapter, four experiments which tested some of the predictions following from the analysis in chapter 5, are reported.

Introduction

Before discussing the experiments, something needs to be said about the existing body of work on the understanding of figurative language. Interest in figurative language has arisen in two areas in particular; normal development, and breakdown in clinical populations. While these areas are extensive enough to provide material for several chapters, the general discussion here raises only those issues that relate to the analysis of figurative language provided by Relevance theory.

Work on the **development of figurative language in children** has recently been reviewed by a number of authors (see for example, Vosniadou, 1987; Winner, 1988). It is important to point out, however, that the approach to figurative language taken by Sperber and Wilson (1986) and adopted here, is very different from that implicit in most of the developmental work in this area. In an early review, Gardner, Winner, Beckhoff and Wolf (1978) discuss the development of metaphor, proverbs and humour, and put forward a view that seems to represent fairly well the implicit approach of much of the later work. Gardner describes the young child as "mired in a stage of literalism" from which the child gradually comes to "transcend the category boundaries" to realise the existence of "possible worlds" other than the literal (p.28). This would seem to stand in stark contrast to the child's very early-emerging ability to disengage from reality in pretend play, and the ability of the child as early as the third year to appreciate the difference

between physical and mental entities (Wellman & Estes, 1986). The time course described for understanding figurative language is dramatically slower: while Gardner and his colleagues grant that the preschool child may "fashion products of striking originality" in his/her early language, these are "more unique than appropriate" and soon give way to a "period of literalism", which lasts until adolescence, when "the possibility for genuine inventiveness once again returns" (p.28). Even then, Gardner suggests that "This potential will be realised by a minority of the population, chiefly writers and speakers". Gardner is clearly discussing a quite different ability from the sort of figurative language which Sperber and Wilson claim is continuous with loose usage. For example, it would be surprising if pre-adolescent children did not comprehend the indirect and nonliteral utterances that are so commonly used (eg. "that teacher is a monster" or "Can't wait").

There is a difference of approach that may explain this apparent gulf between the work of developmentalists and the theory presented by Sperber and Wilson. In the developmental literature there is a tendency for the interpretation of figurative language to be viewed as a problem solving task remote from communication. So Vosniadou (1987), for example, argues that the ability to produce and comprehend metaphorical language emerges out of the child's undifferentiated similarity notions, developing gradually to encompass a greater variety of conceptual domains. The primary constraint on this development is seen as the limitation of the child's world knowledge and information processing abilities, since development in this area involves transfer of knowledge across conceptual domains.

Relevance theory, on the other hand, considers figurative language only in the context of intentional communication. In this analysis, figurative language does not require any special abilities that are not already necessary for the comprehension of "normal", nonfigurative utterances. For Sperber and Wilson, then, it would be as appropriate to ask at what age normal children understand implicatures and indirect requests, and at what age a child appropriately avoids pedantry - as at what age they comprehend metaphor. These other cases of loose usage are no different in principle from more obviously nonliteral metaphorical uses of language. According to Sperber and Wilson, each utterance achieves optimal relevance in its

own way, and the hearer's interpretation of the intended meaning is guided in each case by the guarantee of optimal relevance which the speaker gives simply by claiming the attention of the hearer.

Why then does competence with metaphors and other tropes appear to develop so late? The time course which emerges from the research is approximately as follows: children under seven years are poor at most metaphor tasks, although they will succeed on physical based metaphors if the task structure facilitates success (more on this later); from 8 to 10 years, metaphors grounded on a direct physical resemblance are understood and can be explained; and by 11 or 12 years, children can reliably interpret most types of metaphor. Success at any age depends greatly on the exact task factors involved (Vosniadou, Ortony, Reynolds & Wilson (1984) discuss such factors in detail). Some experimenters have almost certainly underestimated true competence - for example by providing insufficient context for interpretation of a remark, or asking the child to reflect on their comprehension and not only interpret but explain their understanding of figurative material (a meta-task which, as Karmiloff-Smith (1986) has pointed out, requires quite different and additional skills to those necessary for successful performance of a task "on line"). A more general point can be made, however, about the methodology of research in this area, and that is that tasks rarely address comprehension within a communicative context. This is not simply a lapse of ecological validity, rather researchers have been interested in metaphorical understanding as something separate from metaphorical communication - as the ability to perceive analogies. So, for example, in an experiment by Gardner (1974) children were asked to match polar adjectives (eg. light/dark, happy/sad) to colours, faces, sounds, and the feel of certain objects. Correct "metaphorical" matches were, for example, loud/quiet to yellow/green, or hard/soft to frown/smile. Such paradigms tell us little about children's understanding of metaphorical utterances in the normal communicative context. Similarly, Kogan, Connor, Gross and Fava (1980) used a picture pairing task to assess metaphorical understanding; subjects could pair two out of three pictures, either on the basis of association (a picture of an old man and a picture of a rocking chair) or on the basis of "metaphorical" resemblance (the old man picture with a picture of a knarled tree). For most researchers, then, interest has

focused on the ability to perceive similarity across domains, rather than on the ability to perceive speaker's meaning when expressed non-literally.

In chapter 5 it was suggested that the normal understanding of speaker's meaning would break down if intentions were not recognised. If we extend this argument from abnormal development to normal development, the conclusion might be that understanding of loose usage, including metaphors, would require only the development of first-order theory of mind, and so should emerge at age 4 to 5. However, comprehension of any utterance (no matter how "literal") will break down if the hearer does not share the knowledge necessary to form the contextual implications the speaker intends. This may be the case for some sorts of metaphor, which rely on knowledge about the topic and vehicle which a young child may lack. This may explain why metaphors grounded in physical similarity may be understood sooner than other metaphors (eg. Winner, McCarthy & Gardner, 1980) - since young children may know more about some physical aspects of the world than about certain psychological concepts, such as personality traits.

The experiments reported below, then, differ from much of the literature in this field in being concerned primarily with the subjects' understanding of nonliteral communication as communication.

Research into the breakdown of figurative language in clinical groups has taken a quite different approach, and one more tied to the social function of nonliteral communication. Most work in this area has concerned the pragmatic deficits of adults with right hemisphere damage (Code, 1987 and Bryan, 1988 have reviewed this area). In this group, an inability to interpret metaphorical remarks (Brownell, Simpson, Bihrlé, Potter & Gardner, 1990) appears alongside a failure to understand inferred meaning (Bryan, 1988), nonconventional meaning (Hirst, LeDoux & Stein, 1984), indirectly stated material (Brookshire & Nicholas, 1984), indirect requests (Weylman, Brownell, Roman & Gardner, 1989; Foldi, 1987), and the emotional-prosodic quality of utterances (Ross, 1981). Interestingly, these behavioural impairments have been taken as symptoms of a more basic "impairment in comprehending and using contextual information to derive meaning" (Bryan, 1988, p.113). Despite the common report of social and emotional problems following

right hemisphere damage (eg. in two cases reported by Ross & Mesulam, 1979), these patients' problems with pragmatics have not been investigated in terms of a breakdown of the understanding of intention. Nothing is known about the state of such patients' theory of mind, and ability to attribute mental states. Research in this field will be discussed further, therefore, in chapter 9 - where possible ways in which the assessment of relevance might break down even in a system with intact theory of mind, will be suggested.

The aims of the experiments reported in this chapter are broadly as follows:

- 1) To provide a strict test of the hypothesis that autistic people who pass theory of mind tests (at any particular level) do in fact possess a real understanding of mental states beyond that of autistic subjects who fail (in contradiction to the strategy hypothesis).
- 2) To provide evidence for the explanation put forward in chapter 5, for the range of communicative competence seen among autistic people.
- 3) To use autism as a test case for Relevance theory, which makes strong claims for the crucial role of understanding intention in normal communication.

Relevance Battery

Subjects

The autistic subjects were the same as for the Strange Stories study (chapter 4), with the following exceptions. In the "first-order theory of mind" group of autistics, subject number 189 did not take part in the Relevance battery, and was replaced by subject 179 (who had not been tested with the stories). In the "second-order theory of mind" group, subject 180 was replaced by subject 187. The "no theory of mind" group remained the same as in the Strange Stories study. The MLD controls were as in the Strange Stories study, with the addition of one subject

(number 163) who took part in experiments 1 and 3 of the Relevance battery. Subject characteristics for the three groups of autistics and the MLD controls are shown in table 6.1.

Table 6.1 **Subject Characteristics for Relevance Battery**
(Group means, (ranges) and standard deviations)

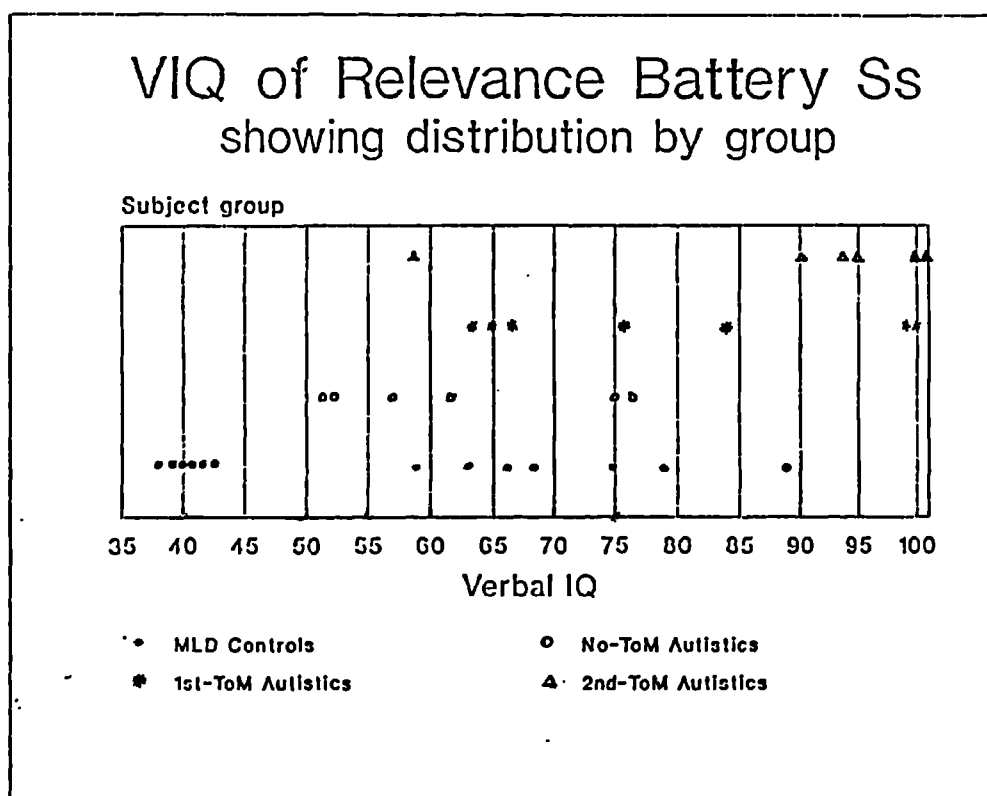
GROUP	N	AGE	V.I.Q.	P.I.Q.	F.I.Q.
MLD	mean 14 (range) s.d.	19.9 (12-38) 8.9	55.6 (40-89) 17.7	-	-
No ToM AUTISTICS	6	17.6 (10-28) 5.9	62.3* (52-76) 10.9	78.5 (46-112) 25.6	67.5 (45-90) 18.1
1st ToM AUTISTICS	6	15.8 (9-25) 5.5	81.5 (64-100) 16.1	87.5 (64-106) 12.9	82.8 (64-102) 12.9
2nd ToM AUTISTICS	6	17.5 (11-26) 4.7	89.5* (58-101) 16.1	94.3 (79-123) 17.5	90.2 (69-112) 14.8

* Significant difference between "no ToM" and "2nd-order ToM" autistics on VIQ; ANOVA, $F(2,15)=5.52$, $p<0.016$; Tukey studentized range method, $p<0.05$.

Every attempt was made to equate the three theory of mind groups for age and ability, and the groups did not differ on performance IQ (ANOVA $F(2,16)=1.01$, $p<0.39$) or full-scale IQ (ANOVA $F(2,16)=3.2$, $p<0.07$). However, as can be seen from table 6.1 and figure 6.1, the groups were not matched for verbal IQ. The no theory of mind group were significantly less able than the second-order group in terms of VIQ only. While this is in some sense a methodological weakness, it is also interesting in itself, and might be seen to follow from the theory of mind differences, according to the model put forward in chapter 5. Although the verbal subscale of the WAIS or WISC-R can in no sense be considered a pure test of

language acquisition, it is tempting to interpret the difference in VIQ in the following way. Having no understanding of intentions, and therefore not paying preferential attention to ostensive stimuli, autistic people without theory of mind would be expected to show pervasive delays and difficulties in acquiring language. It is therefore possible that groups of different levels of theory of mind ability could not be equated for verbal or communicative ability. Moreover, matching groups on verbal ability tasks, may introduce an element of selection in terms of theory of mind, which may explain why some differences between autistic and control groups have been found to disappear when groups are equated for verbal ability (eg. work on emotion recognition, reviewed by Ozonoff, Pennington & Rogers, 1990). However, it would be unwarranted to draw too strong a conclusion from the VIQ differences found here. The verbal subtests of the WAIS and WISC-R may also make greater pragmatic demands on the subject than do the performance subtests, and it may be this pragmatic competence that is revealed as being superior in those autistic subjects who pass theory of mind tasks.

Figure 6.1 VIQ of Relevance Battery subjects, showing distribution by group



In most of the tasks set out below, the comparison of interest is between the three autistic groups of different levels of theory of mind. However, the MLD controls from the previous set of experiments were also given the tasks, and their results are reported where relevant. Since the no-theory of mind autistics are matched with the MLD controls for VIQ, any differences in performance between these groups cannot be due to general intellectual impairment. Similarly, since the first- and second-order theory of mind groups did not differ significantly in VIQ, differences between these two groups on the Relevance battery tasks cannot be accounted for by general intellectual impairments.

Experiment 1 : The Idioms Task

The model presented in chapter 5 suggested that lacking theory of mind would profoundly affect the acquisition of language. While no empirical evidence is available for this hypothesis at present, the finding that autistic subjects who fail theory of mind tasks are significantly disadvantaged on VIQ relative to autistic subjects who pass second-order tasks, supports this claim. In the following experiment, the acquisition of idioms was explored. These figurative expressions have a frozen meaning and so may be acquired in the same way as other vocabulary. Does having a theory of mind help you to acquire learnt language such as idioms? The idioms task also tests experimentally the often anecdotally reported preference for literal interpretations (eg. Coleman & Gillberg, 1985), which according to the model presented above (p.136) would follow from a lack of understanding of mental states.

Method

Subjects were presented with the idiom materials shown in appendix III. The following instructions were given; "Here is a list of things people say. I want you to help me decide what people mean when they use these expressions". Instructions were modified according to the subject's ability, until the subject appeared to understand. With some more able subjects the following instructions were used;

"If a foreigner asked you what these expressions meant, what would you say?" Subjects were then shown the two alternative meanings on the right of each expression, and asked to pick "the one that best captures what people mean when they say X". All subjects appeared to understand the task and were able to choose one from each pair. The idioms and meanings, one of which was literal and one of which was idiomatic, were read out to the subject as often as desired, and the sheet was visible at all times, to reduce any memory load. The subject or experimenter circled the chosen alternative for each idiom.

Subjects scored a point for each idiomatic alternative they chose (in all cases an idiomatic meaning was the appropriate answer) giving a score out of 10.

Results

The performance of the three groups of autistic subjects and the MLD controls can be seen in table 6.2 and figure 6.2. A score of less than 5 out of 10 was considered evidence of a preference for literal interpretation, while a score of 5 or above showed some appreciation of the figurative meanings of the idioms.

Table 6.2 **Idioms Task Results**

	Subjects preferring LITERAL interpretation		Subjects preferring IDIOMATIC interpretation	
	%	N	%	N
MLD (N=14)	21.4	3*	78.6	11
No ToM Autistics (N=6)	83.3	5*	16.7	1
1st-order ToM Autistics (N=6)	50	3	50	3
2nd-order ToM Autistics (N=6)	16.7	1*	83.3	5

* Pearson chi square=6.706, df=1, p<0.009. Fisher exact test (1-tail) p<0.018.

Idiom Task Results MLD and Autistics by ToM

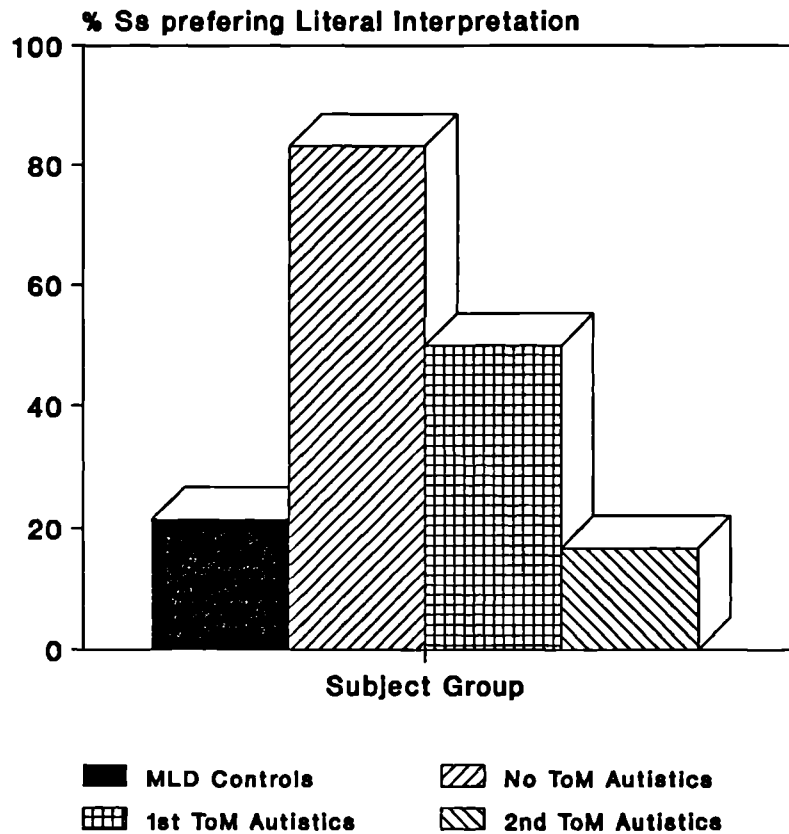


Figure 6.2 Idioms task results: percentage of subjects preferring literal interpretation

As can be seen in table 6.2 most of the autistic subjects with no theory of mind showed a strong preference for literal meaning. Even the second-order group, most of whom did show an understanding of the idiomatic meanings, showed a less pronounced preference for idiomatic meaning than the MLD controls. This is striking since this autistic group had a significantly higher VIQ than the controls.

While experience may seem a very important factor in knowledge of idioms, this alone cannot explain the poor performance of most of the autistics: the MLD group was composed of children under 14 years, and adults who had spent most of their

lives in long-term mental institutions. Also, the three autistic groups did not differ in terms of schooling, age or any other factor obviously associated with experience.

The same pattern of results appears when the groups are compared on number of idiomatic (versus literal) choices made (table 6.3).

Table 6.3 Idioms task results: numbers of idiomatic choices made

GROUP	Number of Idiomatic judgements (max=10)		
	mean	(s.d.)	range
No ToM Autistics	2.17*	(2.23)	0-6
1st-order ToM Autistics	5.00	(2.97)	2-10
2nd-order ToM Autistics	7.00*	(3.23)	2-10

ANOVA $F(2,15)=4.39$, $p<0.032$.

*Tukey studentized range method, No ToM different from 2nd ToM, $p<0.05$.

Here too, the autistic subjects who failed the theory of mind tasks perform significantly differently from those who pass.

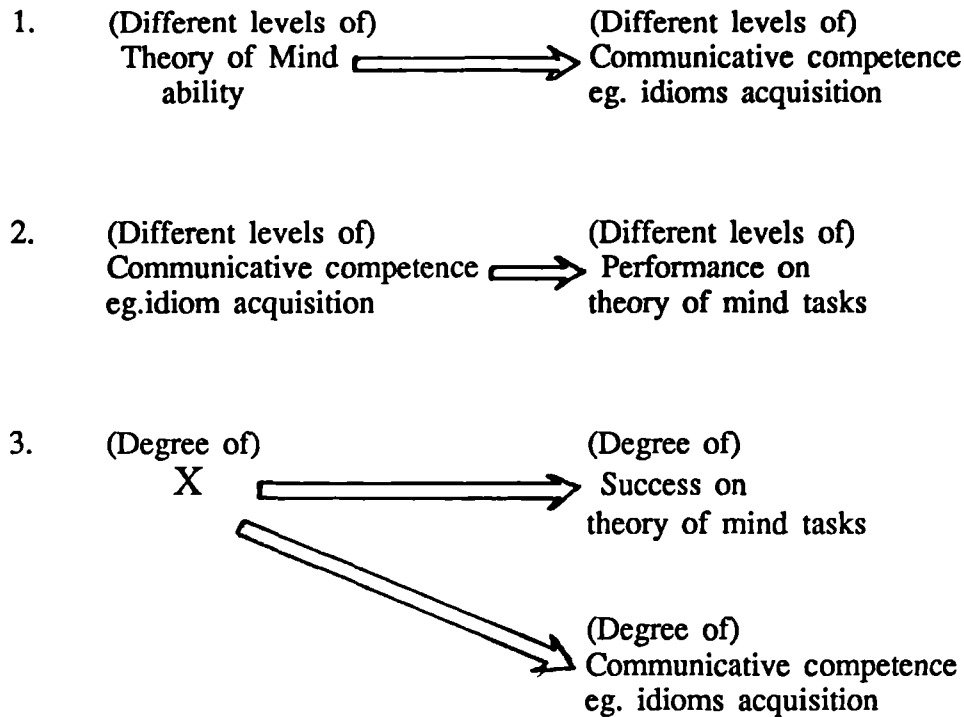
Discussion

The idioms task gives experimental evidence of the autistic tendency toward literal interpretation of language often reported by teachers and parents of autistic people. That 5 out of the 6 autistic subjects with no theory of mind ability chose a literal interpretation is striking in view of the finding in the literature, that normal subjects do not appear to access a literal interpretation at any stage during idiom comprehension (Gibbs, 1980). The different performance of the three autistic groups suggests that autistic literalness is due to the inability to attribute intentions, and that this goes together with the inability to attribute other mental states, such as false beliefs, in the theory of mind tasks.

The results from this task, however, are open to more than one interpretation, as shown in figure 6.3 below.

Figure 6.3

Three Possible Interpretations of the Idioms Task Results



Chapter 5 suggested that different degrees of understanding of intentions (ie. different levels of theory of mind ability) directly cause differences in communicative competence, found in idiom comprehension here and on the WISC-R/WAIS (option 1). The causal relation between communication and theory of mind abilities might, however, be in the opposite direction (option 2). This has been suggested by, for example, Eisenmajer and Prior (1991). These authors found that the 11 autistic children who passed first-order false belief tasks in their study had significantly higher VMA (from PPVT) than the 18 who failed (9 years versus 6:6). They also found differences in the subjects' ability on a measure of pragmatic skill designed for 3- to 9-year-olds. They argue from this relation between verbal ability and theory of mind success in their subjects, that autistic failure on false belief tasks is simply a function of poor language skill, and hence does not indicate a primary, core deficit in autism. A third possible interpretation of the idioms task results is that some third factor (X) - at the same level - affects

both performance on theory of mind tasks and communicative competence (option 3). (Note; it is important to recognise that X in this case is at the same level as the communication and theory of mind problems - clearly, option 1 does not rule out the possibility that the theory of mind deficit is in turn caused by something at, or describable at, a lower level - such as loss of the area of the brain which is responsible for forming representations of mental states). Personality might be one such general factor X, with more "outgoing" autistic children paying more attention to and asking more questions about both idiomatic language and situations of misunderstanding and deception. Such children might not have a theory of mind, but might have learnt appropriate answers for the theory of mind tasks just as they have learnt the now-frozen meanings of the idioms.

The following experiments go some way towards addressing this alternative, as well as exploring the "depth" of the autistic subjects' understanding of mental states, since they deal with skills of generating meaning that cannot be accounted for by rote learning. The more precise predictions tested in the following experiments are designed to give results that can distinguish between the options presented above. In these experiments the precise relations predicted between theory of mind ability and understanding of simile, metaphor or irony, cannot be accounted for simply in terms of a third, general factor (such as personality, experience, teaching or problem-solving ability) as in option 3. It is hard to imagine any general factor that would lead to success in understanding simile but not metaphor, or metaphor but not irony. The same argument can be made concerning option 2 - the very specific predictions tested here would not follow from a model where level of language skill accounts for theory of mind performance.

Experiment 2: Simile versus Metaphor

Chapter 5 dealt with the predictions made by an interpretation of Relevance theory in the light of Leslie's (1987) "metarepresentational conjecture". One prediction was that autistic people with no theory of mind and no understanding of intentions, would fail to appreciate "loose usages". These individuals could only operate with

language, it was suggested, by taking the implicature of the utterance to be its literal meaning. For this reason they would be pedantic, and for this reason they would fail to understand figurative language. This inability to recognise the speaker's thought behind the utterance, and that thought's more or less loose relation to the utterance, means that such autistic people are **never** communicating like normal people. However, this difference will be more or less obvious according to the type of utterance used. So, when language is used **purely** literally (a surprisingly rare occurrence in normal communication, where indirect utterances are common), autistic people without a theory of mind may get by fairly well. However, when a literal interpretation will not suffice, the real communication handicap these people suffer should become evident.

In this experiment, two types of figurative language which have been considered equivalent by many developmentalists (Ortony, 1979; Miller, 1979), and which may be treated much the same by normal communicators, were used to reveal the problems of the "no theory of mind" autistics. Similes, by including the terms "as" or "like", render the comparison they express **literally** interpretable. Metaphors, on the other hand, by omitting this term, are rarely literally true. So for example, it makes sense literally to say, "he was like a tree", but it does not make sense to say "he was a tree" if the utterance is interpreted literally. Can the word "like" make so much difference? Not to normal communicators, who divine in either case the speaker's intention (which might be exactly the same in the two examples above). To autistic people without theory of mind, however, the prediction is that the difference will be tremendous.

Method

The task materials can be seen in appendix III. Each subject received three conditions; Simile, Metaphor and Synonym. The Synonym condition was a control condition to check that subjects could understand the task: it involved only literal, semantic word knowledge. In each condition the subject was asked to choose a word from a list of target words, to finish each of five sentences. The list of target words contained 6 items, that is the five target words plus one distracter item that was not a correct conclusion to any of the sentences. Subjects were not prevented from using the same word twice, so no item could be worked out through

a process of elimination. The sentences that the subjects had to complete were read out to the subject as often as desired and were in full view throughout the task. The subject's choice for each sentence was recorded, and a score out of 5 given for each condition.

The sentences themselves were balanced for condition. That is, they appeared equally often in each of the three possible conditions. The order in which the subjects received the three conditions was counterbalanced across subjects.

Results

The results can be seen in table 6.4, and graphically in figure 6.4. An ANOVA with repeated measures (with the three conditions as three levels of the independent variable), showed a significant group by condition interaction ($F(4,30)=4.39$, $p<0.007$). Although the no theory of mind group was worse than the other groups on the control Synonym and on the Simile condition, this difference was not significant (Tukey, $p<0.1$). The no theory of mind group differed significantly, however, from the first- and second-order theory of mind autistics on the Metaphor condition.

Table 6.4 **Sentence Completion Task**
Results from autistic Ss in 3 ToM groups

GROUP	SYNONYM mean (s.d)	SIMILE mean (s.d.)	METAPHOR mean (s.d.)
No ToM Autistics	3.67 (0.82)	2.83 (1.33)	1.50* (1.05)
1st ToM Autistics	4.17 (0.75)	4.33 (0.82)	4.17 (0.75)
2nd ToM Autistics	4.67 (0.82)	4.33 (0.82)	4.50 (0.55)

* No-ToM group perform significantly worse than other two groups, ANOVA $F(2,15)=24.75$, $p<0.000$; Tukey studentized range method, $p<0.01$.

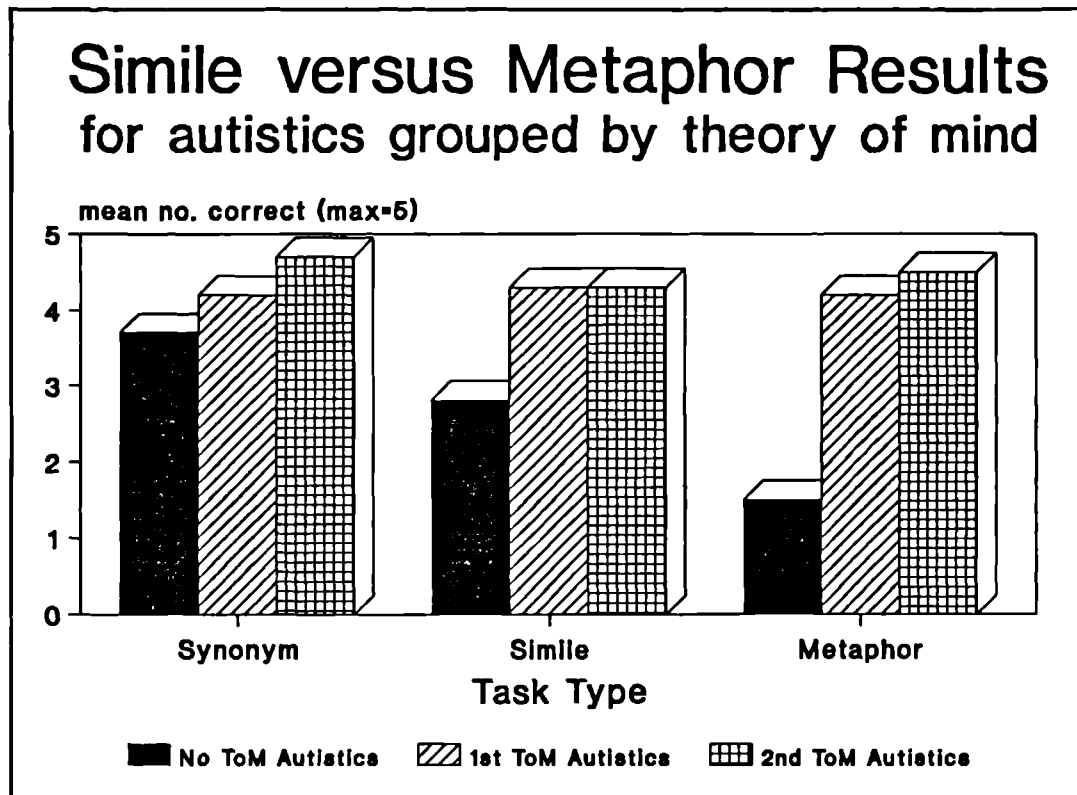


Figure 6.4 Simile versus metaphor results: autistics grouped by theory of mind

In addition, the results of the autistic subjects with no theory of mind can be compared with those from the MLD controls, who are matched with them on verbal ability (see table 6.5 and figure 6.5 below).

Table 6.5 **Sentence Completion Task**
Results from MLD controls and autistic Ss in No ToM group

GROUP	SYNONYM mean (s.d)	SIMILE mean (s.d.)	METAPHOR mean (s.d.)
No ToM Autistics	3.67 (0.82)	2.83 (1.33)	1.50* (1.05)
MLD Controls	4.00 (0.71)	3.69 (0.75)	3.39* (0.65)

* ANOVA, subject group by task type, $F(2,34)=4.86$, $p<0.014$. Tukey studentized range method, $p<0.01$.

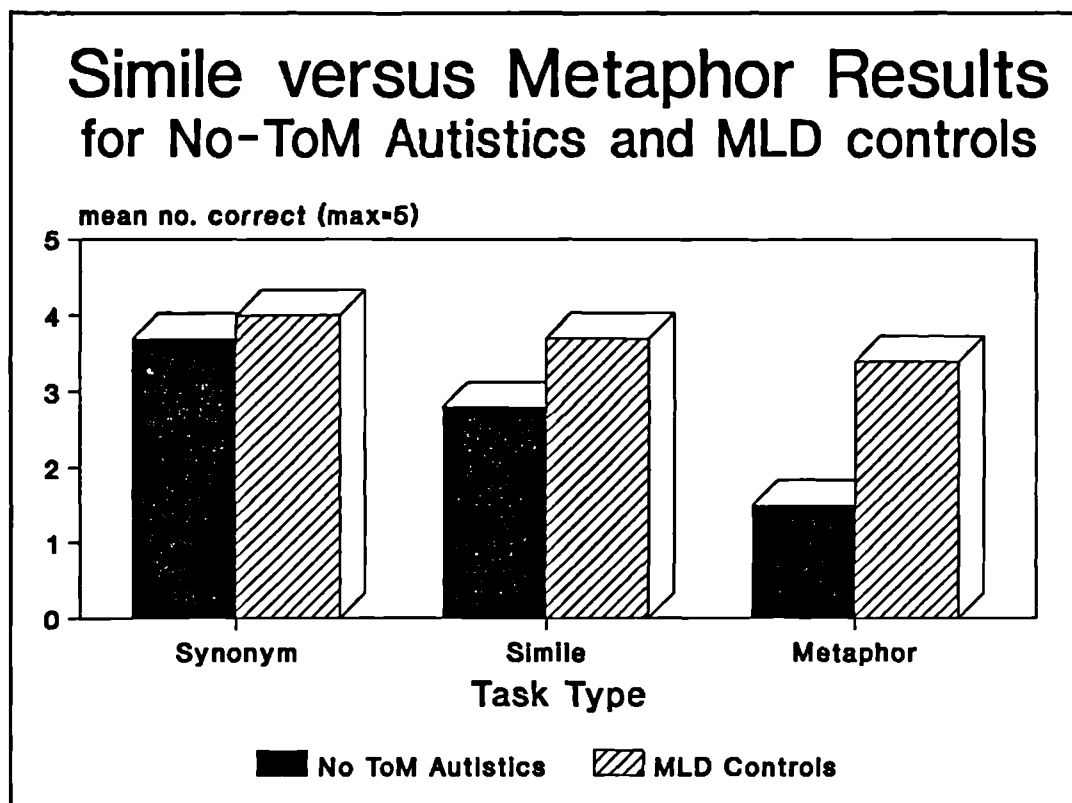


Figure 6.5 Simile versus metaphor results: "no theory of mind" autistics versus MLD controls

The no-theory of mind autistic group's performance does not differ from the MLD controls' in either the synonym (one-way ANOVA, $F(1,17)=0.83$, $p<0.375$), or the simile condition (ANOVA, $F(1,17)=3.30$, $p<0.087$). However, the autistic subjects do perform significantly less well than the controls in the metaphor condition of the sentence completion task. This pattern of findings suggests that the no theory of mind autistic subjects do not fail to understand metaphor due to a general lack of verbal ability - these subjects are matched with the MLD subjects on VIQ. The results suggest that it is only when an utterance must be understood as an expression of a **thought** that the autistic subjects are at a disadvantage compared with other, non-autistic, mentally retarded individuals.

Discussion

As predicted, the simple insertion of the word "like" rather than "really was" had a tremendous effect on the performance of the autistic subjects with no theory of mind. That this group managed (on average) to choose the right term to complete a simile in around 3 out of the 4 sentences is surprising and impressive. These results tell us about the abilities and deficits behind the common observation of literal understanding of figurative language in autism. Since they fulfil the predictions made by Relevance theory about the necessity of representing intention for understanding normal "loose usage", these results add weight to the claim that the three autistic groups are meaningfully different. Dividing the subjects on the basis of their performance on theory of mind tasks created groups that performed very differently on a quite distinct task. This supports the validity of theory of mind tasks, and suggests that at least the no theory of mind group really differs from the two groups with some theory of mind, in their understanding of mental states, in particular intention.

Experiment 3: Metaphor versus Irony

Irony may be defined as the use of words to express something other than, and especially the opposite of, the literal meaning of an utterance. An ironic utterance usually is, but need not be, also an instance of sarcasm, that is a bitter or wounding remark. Work in the developmental literature on the understanding of irony has suggested that children as old as 13 cannot reliably interpret irony, and tend to misjudge it as deception (Demorest, Meyer, Phelps, Gardner & Winner, 1984; Demorest, Silberstein, Gardner & Winner, 1983). Other studies place this achievement at a younger age (Winner, 1988), although most authors agree that children under 6 years old consistently fail (Ackerman, 1983, 1986). Although work in this area is more focused on figurative language as communication than the work on metaphorical understanding, the analyses in most of the developmental literature are still quite different from Sperber and Wilson's (1986, 1981; Sperber, 1984) theory of irony. Sperber and Wilson suggest that irony involves mentioning

some attributed thought, with a mocking attitude. Gibbs (1986) has explored this "echoic mention theory" in normal adult subjects. From the results of three reading-time studies, Gibbs concluded that subjects do not need to process the literal meaning of a sarcastic utterance before deriving their non-literal interpretation, and that the ease of processing and memory for sarcasm depends on how explicitly speaker's utterance echoes a putative belief, opinion or statement. These findings lend support to Sperber and Wilson's theory. However, their echoic mention theory has yet to be tested developmentally.

The echoic mention theory of irony suggests that irony is different from other figurative language in requiring the recognition of a thought about an attributed thought - second-order metarepresentation. As such, irony should present problems of interpretation to subjects with only first-order theory of mind skills, be they autistic or young normal subjects. The relation between metarepresentation capacity and irony comprehension has received some attention from Winner and Leekam (1991), who predicted that second-order belief attribution ability would be necessary to distinguish irony from deception. They found that, as predicted, ability to judge the emotional tone of an utterance (nice for white lie, nasty for irony) was dependent on ability to judge the speaker's desire about the hearer's belief (wants hearer to believe what he says in white lie, wants hearer not to believe in irony). The authors did not, however, test theory of mind understanding outside the irony/white lie story. In the following two experiments, the prediction that comprehension of irony requires representation of second-order metarepresentations was tested in autistic and young normal subjects.

a) Understanding of metaphor versus irony in autistic subjects grouped by theory of mind performance

Method

Subjects (as specified above) were tested individually, and were read the stories shown in appendix III. They were asked the test questions shown, about what the story characters meant by their ironic or metaphorical utterance, and were prompted, following their reply, with the forced-choice question shown. Results are reported

for the subjects' answers to the forced-choice question, since in almost all cases subjects required some prompting. Subjects' performance was scored out of five for metaphor and five for irony, the correct answer in each case being that implied by the story (shown in brackets in appendix III).

Results

Subjects' performance on the five metaphor and five irony questions can be seen in table 6.6 and figure 6.6 below. The lack of variance in the scores of the second-order theory of mind autistics meant that an ANOVA could not be performed. Instead, Kruskal-Wallis tests showed that there were significant group differences on both the metaphor and the irony conditions ($H=10.6$, $df=2$, $p<0.01$). Follow-up comparisons of the two closest groups, using Mann-Whitney tests showed that the significant differences lay between the no theory of mind group and the first-order group in the metaphor condition ($U=1.5$, $p<0.005$ 1-tailed), and between the first- and second-order theory of mind groups in the irony condition ($U=3$, $p<0.001$ 1-tailed).

Table 6.6 **Metaphor vs. Irony Task**
Results from Autistic Ss in 3 ToM groups

GROUP	METAPHOR (max=5) mean (s.d.)	IRONY (max=5) mean (s.d.)
No ToM Autistics	2.33 ^a (0.82)	1.33 (0.52)
1st ToM Autistics	4.67 (0.82)	2.50 (1.76)
2nd ToM Autistics	5.00 (0.00)	5.00 ^b (0.00)

^a No ToM group worse than first-order group, $p<0.005$ (first- and second-order groups not significantly different, $U=15$).

^b Second-order theory of mind group better than first-order group, $p<0.01$ (no theory of mind and first-order groups not significantly different, $U=10$).

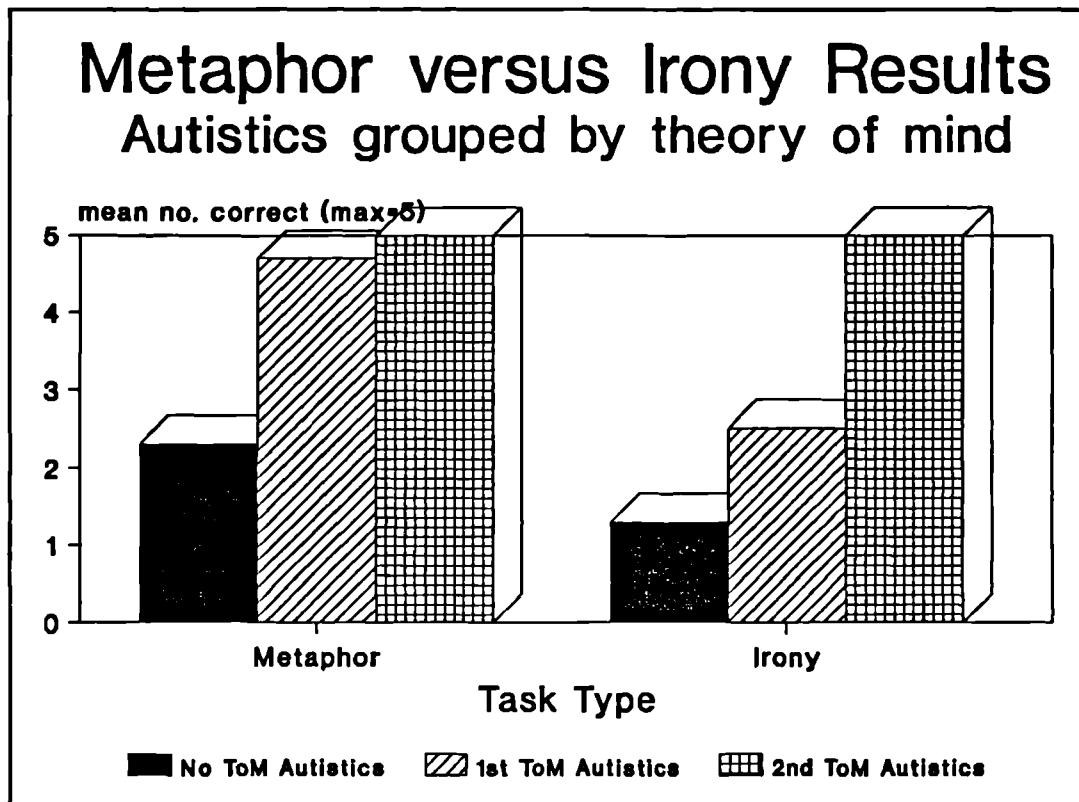


Figure 6.6 Metaphor versus irony results: autistics grouped by theory of mind

As can be seen in the table, no-theory of mind autistics differed from both first-order and second-order theory of mind autistics on the metaphor task, while the two groups with some theory of mind did not differ. This confirms the finding in experiment 2, that first-order theory of mind is vital for the comprehension of metaphor. The first-order autistic subjects differ from the second-order theory of mind subjects, however, in their understanding of irony, being significantly worse at choosing the correct, non-literal interpretation of ironic utterances.

As in experiment 2 above, it is also informative to compare the performance of the autistic subjects in the first-order theory of mind group with that of the MLD controls. These results can be seen in table 6.7 and figure 6.7 below.

Table 6.7 **Metaphor vs. Irony Task**
Results from 1st-order ToM Autistic Ss and MLD controls

GROUP	METAPHOR (max=5) mean (s.d.)	IRONY (max=5) mean (s.d.)
1st ToM Autistics	4.67 (0.82)	2.50* (1.76)
MLD Controls	4.71 (0.47)	4.36* (0.63)

* MLDs perform significantly better than 1st-order ToM autistics (ANOVA, group by task, $F(1,18)=20.55$, $p<0.000$).

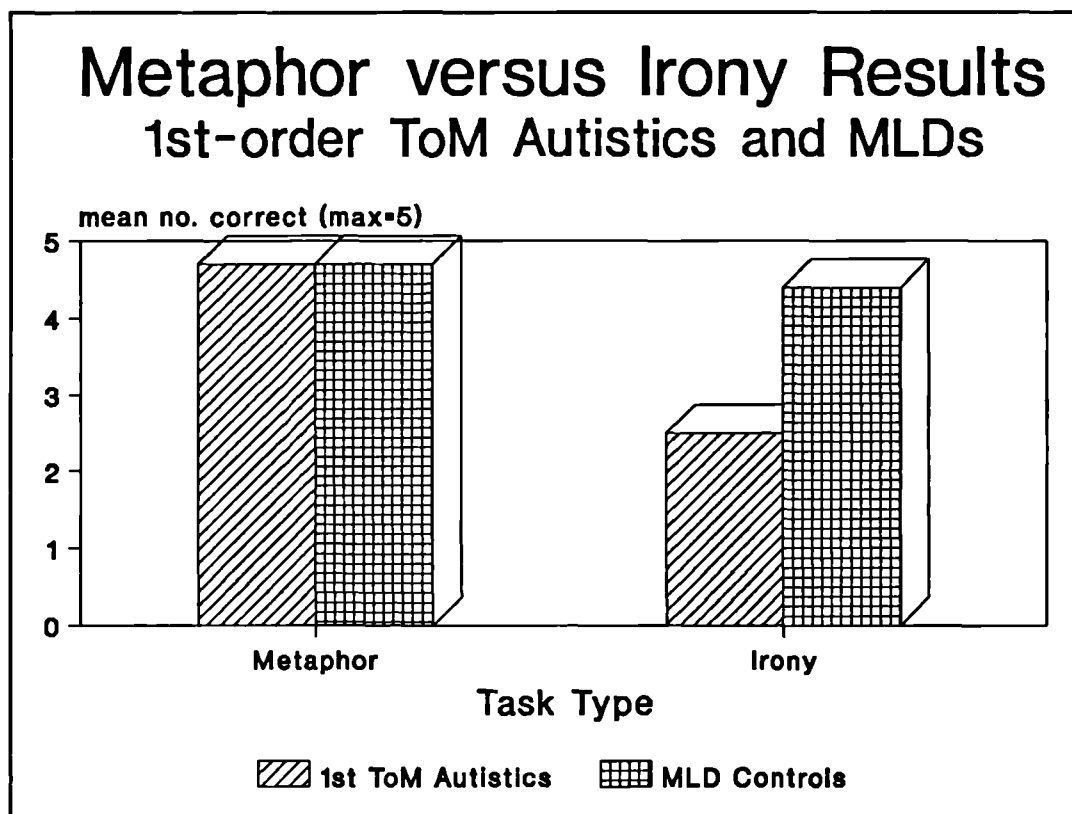


Figure 6.7 Metaphor versus irony results: "first-order theory of mind" autistics versus MLD controls

There was no significant difference between the autistic and controls' performance on the metaphor condition, but the MLD subjects performed significantly better than the first-order theory of mind autistics in the irony condition. Since the MLD subjects had lower VIQ than these autistics, this finding makes it unlikely that the first-order theory of mind autistics' poor performance on irony questions was due

to poor general verbal skills. Despite a quite low VIQ, subjects in the MLD group, who all showed second-order theory of mind ability, were able to interpret ironic utterances in a story context.

Discussion

The prediction that second-order metarepresentation is necessary to comprehend irony, as an expression of speaker's attitude to an attributed thought, was confirmed in the autistic subjects. The tendency towards literal interpretation of metaphoric and/or ironic utterances is once again striking. Numerous studies now exist to support the contention that the literal form of such utterances are not processed by normal adult hearers. Gibbs (1984) reviews much of this research and concludes that for normal communicators, "the distinction between literal and metaphoric meanings...[has] little psychological validity" (p.275).

b) Understanding of metaphor versus irony in Young Normals with and without second-order theory of mind

Subjects

The subjects for this experiment came from a large comprehensive school in outer London. Subject characteristics are shown in table 6.8 below. As can be seen from the table, the two groups were equated for both age and verbal ability. The only feature that distinguished the children - as far as could be seen - was second-order theory of mind understanding.

Table 6.8 **Subject Characteristics**
for Normal Children in Metaphor/Irony Task

GROUP*	N	AGE		VIQ	
		mean	range	mean	range
Failers	9	5:4	4:10-5:8	99.7	92-124
Passers	5	5:3	4:9-5:8	97.6	84-108

* Subjects grouped according to performance on a second-order false belief task.

Method

Subjects were tested alone in a quiet room, as described above. In addition, these subjects were given the British Picture Vocabulary Scales (BPVS) as a test of verbal ability. Lastly, subjects were given the Sally-Ann task and the ice cream van task from the theory of mind battery. All subjects passed the first-order (Sally-Ann) task, and were allotted to the second-order theory of mind passers or failers groups on the basis of their performance on the second-order (ice cream van) task. Subjects were asked for justifications in the latter task, but these were not used to allot subjects to theory of mind groups, for the reasons given in chapter 3 (p.92). All subjects were given the theory of mind tests last, since testing was done by the same experimenter, and knowledge of child's theory of mind group might have introduced unintentional bias into administration or scoring of the metaphor-irony task. The order of presentation of the metaphor-irony tasks and the BPVS was varied systematically.

Results

The results for the young normals grouped by performance on the second-order theory of mind task are shown in table 6.9, and graphically in figure 6.8.

Table 6.9 **Metaphor/Irony Task Results
for young normal children
(Group means and ranges)**

GROUP	METAPHOR mean (range)		IRONY mean (range)	
Failers	4.7	(4-5)	1.6	(0-3)
Passers	4.6	(3-5)	4.6	(4-5)

Statistical analysis was unnecessary for these results, since there was no overlap between the performance on irony of the passers and failers. All the second-order theory of mind passers scored near-perfectly on irony (4 or 5 out of 5), while the failers scored no more than three out of 5. Both groups were at ceiling on

metaphor comprehension, however, supporting the claim that first-order theory of mind only is necessary for understanding metaphor.

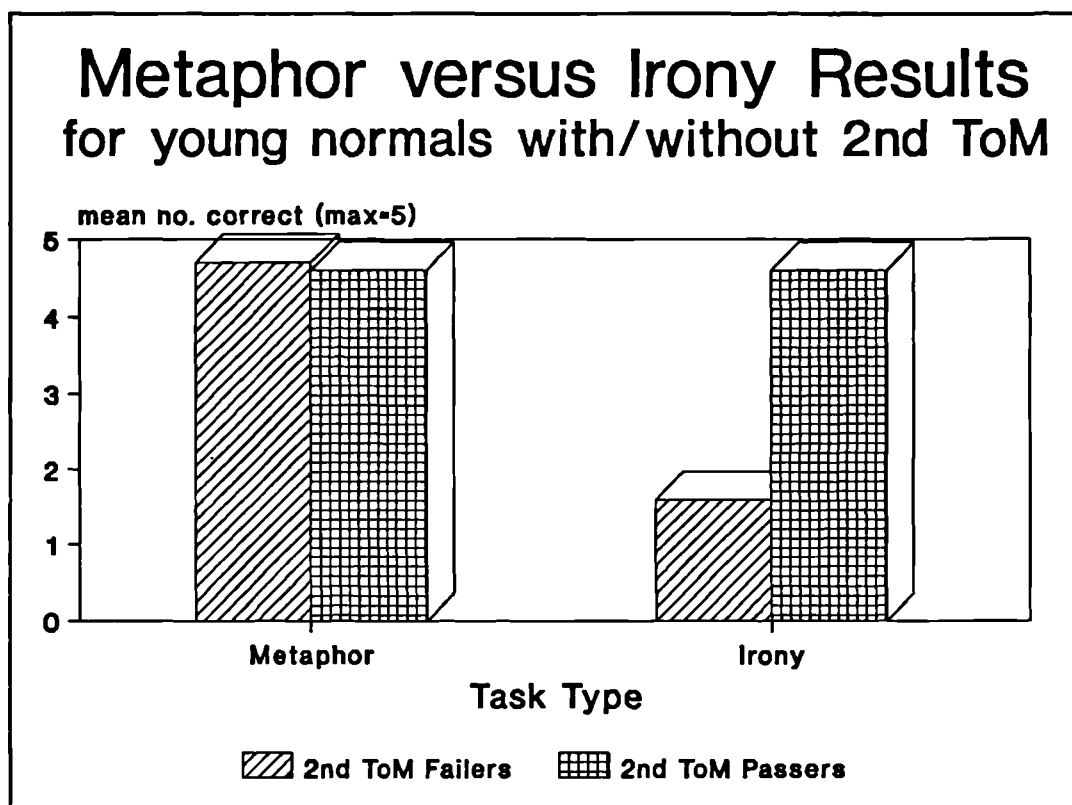


Figure 6.8 Metaphor versus irony results for young normals with/without second-order theory of mind

Discussion

In young normal children, as in the autistic subjects, performance on second-order theory of mind tasks is a very good predictor of comprehension of irony. The finding in both experiments that only second-order theory of mind passers understand irony supports Sperber and Wilson's theory of irony, as involving an utterance which expresses the speaker's thought about an attributed thought. The results also support the validity of our subgroups, which are distinguished only by theory of mind task performance. Whatever differs in the first-order versus second-order theory of mind groups has a demonstrable association with communicative competence, as tested here.

The success of the normal young passers on the irony task is surprising in view of the developmental literature, which rarely credits children under seven with comprehension of irony. The earlier than usual success may be in part due to the forced choice prompt question, and to the absence of any taxing memory component in the present task. The subjects here were also fairly young to pass second-order theory of mind tasks. Perner and Wimmer (1985) found that few children passed such a task (including giving a correct justification for their answer) before the age of 8 years. However, here passing and failing was assessed by performance alone, and a correct mental state justification was not required - since this emerged in chapter 3 as an overly strict criterion. In addition, efforts were made to find children of the same age who passed and who failed. Thus the children included were probably just at the turning point between first-order only and second-order theory of mind ability. It was also the aim to test representative normal children - not subjects who were either grossly delayed in theory of mind or especially precocious. As a result, the passers were probably only recently capable of passing, and the failers probably on the verge of understanding. This makes the dramatic difference found in understanding irony all the more striking.

Relevance Battery Summary and Conclusions

The predictions about the degree of theory of mind necessary for understanding simile, metaphor and irony were confirmed here. Autistic subjects who failed all the theory of mind tasks had a significantly lower verbal IQ and a greater tendency to literal interpretation of idioms. Despite this, they were able to complete sentences involving a simile, but failed when the phrase "was like" was replaced by "really was". Autistic subjects of the same age and ability, but who passed first-order theory of mind tasks, were able to complete and comprehend metaphors, in two separate tests, but failed to understand ironic utterances, attributing an incorrect, sincere/literally true meaning to the speaker. Autistic subjects who passed second-order theory of mind tasks, however, comprehended not only similes and metaphors, but also irony. In a small sample of normal children, divided into two groups on the basis of performance on the ice cream van task, second-order theory

of mind performance was again predictive of performance on the metaphor/irony task.

The results also support Sperber and Wilson's analysis of figurative language. For example, the results of the irony task were predicted by these authors' echoic theory but not by previous classical theories of irony. These theories suggested that the literal meaning of an ironic utterance is first computed, and if this interpretation does not fit the context then the opposite meaning will be accessed. Under this analysis, understanding irony would not necessitate any ability which understanding metaphor does not also require, and so classical accounts of irony would predict success by subjects with only first-order theory of mind ability.

In summarising the findings so far, an attempt has been made to refer only to theory of mind task performance, and not to theory of mind itself (ie. underlying competence). In chapter 2 the issue of delay versus strategy was discussed, in relation to the success of a minority of autistic subjects on theory of mind tasks. The experiments reported in this chapter explored the nature of the ability underlying this success. What is different about those autistic people who are able to pass theory of mind tasks? Are they simply better problem-solvers, more able to devise a strategy to answer the theory of mind questions - thanks perhaps to better teaching, more experience, higher IQ or a more sociable disposition? Or is what distinguishes the passers and failers a real difference in insight into other minds, in the ability to represent and manipulate mental states, in short a difference in theory of mind?

From the results of the experiments presented here some tentative conclusions can be reached about this question. Whatever distinguishes the subjects in the three theory of mind groups has a direct and particular association with the comprehension of figurative language. In the absence of other differences between the groups, the confirmation of the predictions made would seem to suggest a real difference in underlying theory of mind competence in the three groups of autistic subjects. The results from the normal subjects reinforce this conclusion. If it seems reasonable to credit the five-year-olds with true differences in theory of

mind ability as an explanation for their different performance on the irony task, it is difficult to deny such a difference in the case of the autistic subjects.

The problem, of course, is that those autistics who pass all the theory of mind tasks fail to show the social competence in their everyday lives that they can show in the test situation. At the end of the battery of relevance communication tasks reported here, there remain a group of autistic subjects who have passed every single test put to them. The second-order theory of mind autistics seem to understand acted-out double bluff and embedded false belief scenarios, idioms, similes, metaphors and irony. And yet they remain handicapped, and fail to show normal social, communicative or imaginative abilities in their everyday life. How can one explain the extreme oddness of even those autistic people who, on the basis of the present argument, do seem to come to have a theory of mind? In chapter 7 a suggestion is made that the normal assessment of relevance may have broken down even in those subjects who possess a theory of mind, due to a failure of central coherence.

Chapter 7

Relevance and Central Coherence

In chapter 5 Sperber and Wilson's Relevance theory was introduced as a framework for understanding the importance of representing intentions in communication. In this chapter we return to Relevance theory, this time to explore how the assessment of relevance might be disrupted by a different cognitive deficit - a deficit in "central coherence". Frith (1989a) proposed such a deficit, prompted by the inability of the theory of mind account to explain many of the nonsocial handicaps seen in autism. The success of some of the autistic subjects tested here on the theory of mind and relevance batteries (despite enduring handicaps in everyday adaptation), also suggests that there may be a more basic and persistent cognitive deficit in autism.

In this chapter, some of the findings which lead Frith to her theory will be reviewed, after which the central coherence hypothesis as proposed by Frith (1989a) will be summarised. Next, a modification and expansion of the original theory, using Relevance theory, will be suggested. In chapter 9, a causal model of the effect of a lack of central coherence on the calculation of relevance will be presented. In this chapter, a single prediction is made concerning the use of context in a homograph-reading task - a prediction which was tested in a study reported in chapter 8.

Background to Frith's notion of Central Coherence

The central coherence hypothesis as put forward by Frith (1989a) can be seen as flowing from two sources; a collection of symptoms and features of autism which remain unexplained and unilluminated by the theory of mind account of autism, and a body of research centring around the autistic child's relative inability to extract and use global meaning. The first source includes features of autism such as the high incidence of savant skills, the motor stereotypies, insistence on sameness and special interests, and the peculiar reactions to sensory stimuli. The second source

includes work begun by Hermelin and O'Connor, and by Frith herself, exploring the use of meaning and pattern in autistic memory and problem solving. This work, and more recent studies on this theme, are discussed below.

Frith (1970b) explored the ability of autistic children to extract and reproduce sequences of coloured counters. While normal children in her experiment picked up the rules in given sequences and generated rule-governed errors, autistic subjects were influenced not by the whole pattern but by the last single element alone, and their errors were due to simple perseveration or alternation independent of the pattern given. Frith refers to the autistics' tendency for "pattern imposition" rather than "pattern detection". She concludes that "autistic children are insensitive to differences in the structures presented and tend to impose their own simple stereotyped pattern, while normal children impose such patterns in the absence of structured input only" (p.120). In a later study (Frith, 1972), she explored the idea of "pattern imposition" in autism, by looking at the spontaneous production of sequences by autistic, normal and MA-matched mentally handicapped children. The children were simply allowed to play with 2 or 4 colour stamps and 2 or 4 bars on a xylophone. Frith reports that the autistic group showed a tendency "to use simple rules rigidly, resist available elements and avoid rare patterns", which was not found in the controls.

Boucher (1977) also explored autistic children's response to novelty and spontaneous choice of sequencing behaviours. Her study, which involved the subjects choosing which of 2 or 3 "garages" to drive a toy car to, resembled Frith's work but used more able subjects and presented spatially-defined choices. Her results and conclusions are similar to Frith's - that autistic children show reduced alternation and respond less to the availability of novel items. She concludes that autistic children at all ages and ability levels tend to stick more strictly to simple rules than do controls. While Boucher defends the use of a pseudo-pretend scenario - where the child is prompted to think about the locations as "home", "shops", "petrol station" and so on - on the basis that autistic children often play with toy cars, it is interesting to speculate on the effects of the introduction of this level of meaning into the task. Manipulating this variable - by presenting the same 3-armed track with or without the "car going to the shops" explanation - might reveal the level

at which autistic use of context and meaning breaks down. Frith's tasks are impressively simple, and as such suggest deficits in quite low level search for coherence in patterns. However in most cases her results show significant differences only for the low MA autistic subjects. Introducing "meaning" at a higher level than pure abstract patterning, meaning which mentally handicapped controls might readily perceive, might show up deficits in even the more able autistic population.

Another demonstration of autistic subjects' failure to extract global meaning is found in their response to the Embedded Figures Test (EFT) and the WISC/WAIS Block Design subtest. Lockyer and Rutter (1970), as well as several later investigators (Bartak, Rutter & Cox, 1975; Wurst, 1976; Tymchuk, Simmons & Neafsey, 1977), report a relative peak in intelligence tests on Block Design. This task requires the subject to construct a pattern from cubes with differently patterned red and white faces, using as a model a picture of the entire pattern. Shah (1988) tested the hypothesis that autistic subjects find this task unusually easy because they are able to "resist the overall pattern, and perceive it instead in terms of the constituent cubes." She found that, as predicted, artificial segmentation of the pattern (by drawing in the grid of cubes) aided normal subjects but not autistic subjects. Shah and Frith (1983) demonstrated that autistic subjects also excel on the Embedded Figures Test - which also requires that the parts of a pattern be attended to and the whole figure ignored. It is interesting to note that in this study the autistic subjects did perceive the whole figure - they could name it as, for example, a house. The authors suggest that despite this the global figure must have been less "relevant" for the autistics than for the normal and MLD controls, allowing the autistic subjects to resist the global aspects of the figure more successfully. Again, it would be interesting to assess the effects of high level "meaning" in this task. In every case in the EFT the global shape represents an object (which is nameable and recognisable) while the local element being searched for is more abstract (eg. a triangle). Thus global versus local preference is confounded by a meaningful versus nonmeaningful choice. It would be easy to create versions of the EFT stimuli where the global figures also were novel and "meaningless", or even where the local figures were recognisably object-like shapes. Comparing performance of autistic and control subjects on such items would reveal more about the level at

which coherence breaks down in autism. There is some reason to think that even without the bias of object meaning, normal perception may show a preference for global aspects of a figure (Navon, 1991, see chapter 9).

A set of studies begun by Hermelin and O'Connor (1967) has explored the effect of meaning on memory in autistic subjects. Their original studies compared 12 autistic subjects (aged 8-14 years) and 12 mentally handicapped controls matched on Peabody Picture Vocabulary MA and on digit span. Testing immediate serial recall of sentences versus word strings, Hermelin and O'Connor found that only the controls benefited significantly from the effect of meaning. The autistic subjects in fact scored more highly than the controls on recall of both the infrequent-word sentences and the random word strings. This finding suggests that autistic rote memory may actually be better than "normal" (ie. that of IQ-matched controls). When Hermelin and O'Connor gave their subjects supra-span word sequences (which in normal subjects prompts recall of related words together) controls showed significantly more clustering of related items in free recall (in 21 of the 36 possible instances versus just 9 of the possible 36 instances in the autistic group). However, on this task there were no group differences in number of words recalled. This may be because in this task chunking items together by meaning was as efficient a processing strategy as rote memory, whereas in the previous task the demands of serial recall made rote memory a more successful method.

The finding that autistic subjects benefit less than controls from the effect of meaning in recall has now been replicated a number of times. O'Connor and Hermelin (1967) found this difference and a five-fold increase in recency effect in their autistic subjects - leading them to propose an "echo box" theory of autistic memory. Aurnhammer-Frith (1969) compared 16 autistic subjects and 16 young normals matched on Peabody VMA and digit span. In free recall of lists of 4 to 14 words she found that high-span normal subjects showed greater facilitation from meaning than high-span autistic subjects.

Other studies with this paradigm have found this result to hold only for low ability subjects. Fyffe and Prior (1978) performed Hermelin and O'Connor's tasks with a group of 20 autistic, 20 normal and 20 mentally handicapped subjects. They

report "consistently lower levels of facilitation of recall for autistic children when structured material rather than random was to be recalled", thus confirming previous results. However, on the basis of insignificant differences in their high-span autistics, they argue that "poorer performance is explicable in terms of a lower developmental level rather than a processing deficit specific to autism" (p.400). This conclusion does not address findings such as Aurnhammer-Frith's (1969), and indeed Schwartz (1981), in a review of this literature, concluded that such discrepancies in results could all be accounted for in terms of inappropriately weak statistical analyses. He claims that, given this proviso, all the studies support the idea that autistic people show less facilitation of memory for meaningful versus meaningless materials than do controls.

Two recent studies have probed the nature of the type of "meaning" from which controls benefit more than autistics. Ramondo and Milech (1984) concluded, on the basis of their tests with materials which varied grammaticality and semantic relatedness independently, that the autistic deficit is in processing syntactic information only. This surprising finding (syntax is usually thought to be unimpaired in autism, eg. Paul, 1987) has been discussed in a recent study by Tager-Flusberg (1991), who makes the important point that the nature of the words used (content versus function words) was not equivalent in the different conditions of Ramondo and Milech's experiment. In her study 15 autistic subjects were compared with 15 CA- and VMA-matched mentally handicapped controls and 15 VMA-matched young normals. Materials were lists of 12 semantically related (all animals) or unrelated nouns. On free recall the autistic subjects were not significantly different at remembering the related versus the unrelated word lists, while the controls benefited significantly from the semantic relation. However, the autistic subjects proved as able as the controls to use semantic cues once they ceased to produce items under free recall. Tager-Flusberg concludes that the autistic deficit lies in a failure to retrieve rather than a failure to recognise or encode the meanings of the items. This fits well with the findings by Boucher and Warrington (1976) that autistic subjects are unimpaired at paired associate learning if tested by cued recall, while being poor at free verbal and picture recall. Tager-Flusberg's result, then, suggests that autistic subjects do encode word meaning, although this does not

indicate that they also encode the relations between words, drawing items together in a coherent fashion within a sentence or string of related words.

Frith's notion of Central Coherence

The above findings, which suggest a failure to extract meaning in autism, together with the still unexplained features of autism such as savant skills, stereotypies and insistence on sameness, form the background for Frith's (1989a) "central coherence" hypothesis. Frith (1989a) proposed a new and still very tentative theory of autism, which pinpointed as the underlying cognitive deficit a failure of the "normal operation of central coherence [which] compels us human beings to give priority to understanding meaning"(p.101). Elsewhere in her book, Frith defines coherence as; "the need to slot information into a larger and larger context" and "the ability to make sense, to see meaning and structure in everything" (p.101). She claims that in autism, "The whole pattern of abilities makes sense when seen as deriving from a cognitive dysfunction of a particular dynamic operating characteristic of a very high-level central thought-process" (p.102). In support of this claim she makes a compelling case for seeing skill on the Embedded Figures Test (Shah & Frith, 1983), stereotypies, peculiarities of perception, and rote memory ability as the result of a lack of central coherence (versus local coherence). For Frith, then, the surprising abilities and striking deficits seen in autistic children have the same cause; it is the autistic child's inability to take account of context that both produces excellent Block Design performance, and leads to their inability to process stimuli for meaning (as demonstrated in the studies discussed above).

Perhaps the best way to convey what is meant by the tentative and exploratory notion of central coherence, is to give an anecdote;

A clinician testing a bright autistic boy presented him with a toy bed, and asked the child to name the parts. The child correctly labelled the bed, mattress, and quilt. The clinician then pointed to the pillow and asked, "And what is this?". The boy replied, "It's a piece of ravioli".

The child in the anecdote was not joking, nor was his sight impaired - indeed the clinician commented that the pillow did indeed look like a piece of ravioli, if taken

out of context. However, normal subjects appear to be constrained in their interpretation of information by the context in which stimuli are presented (eg. Palmer, 1975). The central coherence hypothesis suggests that autistic subjects are peculiarly free from such contextual constraints.

For Frith, the deficit in central coherence is a deeper underlying problem, from which the theory of mind failure results. That is, Frith sees the social world and social interactions as requiring supremely "central", as opposed to peripheral processing. Understanding social interactions, for Frith, is the ultimate challenge to our powers of central coherence. An organism without central coherence stands no chance of recognising all the complex and interwoven facets of the context of social interaction. Frith says of theory of mind and its relation to central coherence; "We interpret behaviours...in terms of hidden states of mind. In this way we can create better coherence of the information processed than we could achieve by merely relating behaviours to events" (p.158).

The notion of central coherence has not yet been systematically developed, and is at present only loosely defined and conceptualised. In particular, it is as yet unclear what is the appropriate level for pinpointing the autistic individual's inability to use context; while success on the Embedded Figures Test suggests a peculiarity even at the level of perception, other features of autism are better explained by a failure of coherence only at higher, conceptual levels.

Extending the Central Coherence hypothesis: Coherence and Relevance

Weak central coherence would cause an inability to derive rich and comprehensive **contextual implications**. It is the processing of information in context that gives the contextual effects which are weighed against processing effort in the estimation of relevance (cf p124). An individual who cannot process information as part of a larger context, therefore, would not derive the normal contextual implications, and hence his calculation of relevance would be peculiar.

A second effect of weak central coherence might be an effect on rote memory ability. This might in turn effect the costs of processing in the costs/benefits equation of Relevance theory. Throughout Relevance theory it is stressed that the interpretation of ostensive behaviours (such as utterances) is guided by the inability to tolerate nonsense and irrelevance. For example, it is said to be a characteristic of powerful ostensive stimuli such as speech signals, that they are, "stimuli which both pre-empt the attention...and are irrelevant unless treated as ostensive stimuli". Thus the inability of humans to treat utterances as if irrelevant leads to a type of disambiguation of speaker's meaning. What would happen if the cognitive system did not demand meaning, and did tolerate the speaker's message being interpreted as irrelevant? The effects of unusually low processing costs might not be restricted to the realm of ostention. The discussion of Relevance theory in chapter 5 began with the idea that any new, unconnected information that could only be processed piece-meal would not be worth processing, since the costs would outweigh the meagre benefits, and so violate the principle of relevance. But what if such piece-meal processing was not too costly to be pursued? It is an intriguing possibility that in at least some autistic people the same cognitive architecture that allows extraordinarily good rote memory, and outstanding "savant" abilities, could lead to an abnormally low level of processing costs. It may be that such unusual memory ability is a coping mechanism for the inability to process information in context for meaning. The causal directions are hard to establish without experiment. But it is also possible that someone with such good rote memory would never be driven to the cognitively economic measure of processing and storing meaning or gist.

Peculiarities in memory, caused by weak central coherence, might also affect the assessment of relevance in another way. Sperber and Wilson stress, "the crucial importance of the organisation of encyclopedic memory in the pursuit of relevance". It is only due to some degree of assumed universality in memory organisation, and hence in the accessibility and so cost of retrieving contexts, that the speaker can estimate the relevance her remark will have for her listener. If autistic people have radically different memory organisations, this system will break down, and with it communication. It is likely that - whether due to innately different rote memory abilities, the development of superior rote memory to compensate for an inability to process information in context for meaning, or just because of this last inability

- autistic memory will show differences in organisation. In its turn, this difference in memory organisation would alter the costs of processing, which as we have seen are a vital component in the usual calculation of relevance.

Because of the balance of costs and benefits underlying relevance, Sperber and Wilson claim that, "At every stage in disambiguation, reference assignment, and enrichment the hearer should choose the solution involving the least effort, and should abandon this solution only if it fails to yield an interpretation consistent with the principle of relevance" (p.185). It may be that in autistic people those "paths of least effort" are thoroughly idiosyncratic. The implications would be tremendous. In the realm of communication, this might mean that even an autistic person with full understanding of intentions would fail to communicate properly, since their calculation of relevance would be radically different from their conversational partner's. The most accessible processing context for an autistic speaker/listener may quite idiosyncratic - meaning that for them the guarantee of relevance is continually being broken.

The idiosyncratic assessment of relevance (due to poverty of contextual implications, peculiarly low processing costs, or unusual patterns of accessibility of contexts) would also have implications outside the realm of ostention, with the autistic person regularly "disagreeing" with the normal person on what stimuli in the environment are relevant. This would be manifest most clearly in the focus of attention, since our attention turns to what is relevant to us. An idiosyncratic assessment of relevance will therefore lead to an idiosyncratic focus of attention. There is some anecdotal support for the prediction that autistic subjects focus their attention on aspects of the environment which normal people find irrelevant or even hidden (Wing, 1976). This odd focus of attention might have effects on the social handicap and on language acquisition, since the probability of an autistic child sharing its parents' focus of attention will be dramatically lowered (even disregarding for the moment the ostention usually used to ensure joint attention).

The predictions which follow from an integration of Frith's (1989a) notion of central coherence with Sperber and Wilson's (1986) concept of relevance, are considered more fully in chapter 9. First, the claim that the central coherence

deficit characterises autistic subjects of all ages, abilities and levels of theory of mind, is tested.

Testing the Central Coherence hypothesis

The central coherence hypothesis predicts that autistic people, of all ability levels and all levels of theory of mind, will be impaired at extracting the meaning of stimuli in context. In order to test this hypothesis, a task is needed which does not confound demands on central coherence with demands on theory of mind. One such task, which tests use of linguistic context to derive context-dependent meaning, without making demands on theory of mind, has been devised by Frith and Snowling (1983). They gave subjects a homograph reading task, where (since the homographs used were not homophones) correct pronunciation of the word depended on sentence context. This task is a subtle way of assessing use of linguistic context on-line, since the subject is simply asked to read out loud the materials, and use of context to disambiguate pronunciation can be judged non-intrusively from pronunciation. It was this task, therefore that was chosen as a first test of the central coherence hypothesis. Chapter 8 reports the results of the homograph task with the able autistic subjects already tested on the theory of mind and relevance batteries. The prediction, that even those autistic subjects who pass all theory of mind tasks will show a deficit in central coherence on this simple task, is a bold one, as is appropriate for the early stages of exploration and definition of the central coherence hypothesis.

Chapter 8

The Homograph Task

Introduction

In Chapter 7 the concept of central coherence was discussed. The suggestion was made that autistic people are characterised by a deficit in the mind's capacity to draw together diverse information to extract meaning at high levels. This deficit was hypothesised to underlie many of the features of autism not well-explained by the theory of mind theory. A deficit in central coherence was suggested as a continuing handicap in even those autistic people who do seem to gain a theory of mind (with marked delay). In this chapter, an experiment is reported which tested the hypothesis that autistic subjects - at all theory of mind levels - fail to use context to derive global (versus local) meaning.

The method used here involved the reading of homographs which are not homophones (eg. "bow" or "read"), and was taken from work by Snowling and Frith (1986). In a comprehensive series of experiments, these researchers explored the reading skills of hyperlexic children, with and without autism. At the end of 7 experiments, Frith and Snowling (1983) concluded that while the 8 autistic, hyperlexic readers showed normal phonological and syntactic processing, these subjects showed specific impairments (relative to reading age matched dyslexics and young normals) in "reading for meaning". This emerged in their significantly lower comprehension than accuracy scores on the Neale analysis of reading test, in their inability to choose the story-appropriate word to fill in gaps, and in their failure to use context to inform pronunciation of homographs. Concerning this last finding, Frith and Snowling report that the autistic children failed to "use semantic/syntactic context in pronouncing the homographs...(with one exception) they always chose the more frequent pronunciation regardless of context" (p.336). The homograph task used included 5 homographs in 10 sentences - but was extended and improved in the authors' 1986 study, where 20 sentences presented 5 homographs in four

conditions; rare or frequent pronunciation, and before or after context. It is this later version of the homograph task that was used in the experiment reported here.

The homograph reading task has a number of advantages as a method for exploring autistic subjects' processing of context-specific meaning. It is an open-ended task, where the subject is free to process the stimuli in a number of ways. So, for example, this task may reveal peculiarities in the global processing of autistic subjects due not to an inability to process written stimuli for meaning, but rather to a preference for deriving more local coherence (due, for example, to global processing being relatively costly). It seems clear that able autistic subjects are capable of comprehending meaning in text - as in the "Strange Stories", where their understanding of the text was demonstrated by their good performance on the control questions ("Is it true...?"). In the stories task, however, the subjects were required by the experimenter to work out the meaning of the text. By contrast, in the homograph task two quite different processing strategies are available, and no instruction or feedback is given to direct the subject in his or her choice of strategy. The subject can choose either to process the homograph in isolation, in which case the most frequent pronunciation is the "correct" one, or she/he can process the homograph as one element of the sentence context, in which case the context-specified pronunciation will be given. In this respect it is important that the homograph task is a non-intrusive task where little instruction has to be given and where - since being asked to read out loud is a fairly ordinary request - the demand characteristics of the situation (to which autistic people might be expected to be less sensitive) are minimised. Lastly, the task has advantages as an on-line task, which does not require meta-knowledge or the making of reflective judgements - abilities which may make demands on the metarepresentational system, and may be deficient in many autistic people.

Method

Design

The experiment had a repeated measures design. The independent variables were pronunciation type (rare versus frequent), and position of target word relative to context (before versus after context). The twenty sentences were thus of four types;

- Rare pronunciation and target word before sentence context,
- Rare pronunciation and target word after sentence context,
- Frequent pronunciation and target word before sentence context,
- Frequent pronunciation and target word after sentence context.

The dependent variable was number of context-appropriate pronunciations.

Subjects

The autistic subjects in this experiment were those who took part in the experiments reported in chapter 6, divided into three groups according to performance on the theory of mind battery reported in chapter 3. Two subjects who took part in the relevance battery were unable to complete the homograph task, due to insufficient reading skill. One of these was in the "No theory of mind" group (subject number 172), and the other was in the "first-order theory of mind" group (number 177).

Controls for this experiment were normal young children, matched on total number of context-appropriate pronunciations in the homograph task. These subjects came from an outer London comprehensive school. While it had been intended to use the mentally handicapped subjects from the theory of mind and the relevance battery experiments as controls, only one of these subjects was able to read the experimental materials. Subject characteristics, for the autistic and young normal groups, can be seen in table 8.1.

Table 8.1 **Subject Characteristics for Homograph Task**
(group means, ranges in brackets)

GROUP	NO.	VIQ	AGE (yrs)	TOTAL (Max=20)
Normal Controls	13	---	7:7 (7:2-8:2)	15.1 (13-18)
All Autistics	16	79.6 (52-101)	17:7 (8.9-28.2)	14.97 (10-20)
Autistics grouped by ToM:				
No ToM Autistics	5	64.4* (52-76)	18.9 (13.5-28.2)	13 (10-17)
1st ToM Autistics	5	84.8 (64-100)	16.6 (8.9-24.6)	15.2 (10-20)
2nd ToM Autistics	6	89.5* (58-101)	17.5 (11.5-25.5)	16.7 (13-20)

* VIQ of "second-order theory of mind" group is significantly greater than that of "no theory of mind" group (ANOVA $F(2,13)=4.47$, $p<0.033$; Tukey's test $p<0.05$).

Materials

The homograph materials were taken from Snowling and Frith (1986). Materials were identical except for two sentences, which were felt to involve social factors which might put the autistic subjects at a disadvantage for comprehension. These were a sentence about a dog "knowing" that it was going to be taken for a walk, and a sentence about two boys "pretending" to be cowboys and indians. These were replaced by similar sentences without these directly "mental" aspects. The full set of twenty sentences can be found in appendix IV. The sentences were typed and stuck onto plain white cards. In addition, a list of single words, including the five homographs, was presented to the subjects to test for the ability to read, and for normal pronunciation of the target words.

Procedure

The procedure followed that outlined by Snowling and Frith (1986). Subjects were tested individually in a quiet room. They were first asked to read out loud the list of words, to check for correct pronunciation of the homographs. Only 2 autistic subjects and 3 normal children gave the less frequent pronunciation of a homograph in this pretest. All other subjects used the more frequent pronunciation - and this did not differ in the autistic and normal groups. The subjects were then presented with the twenty sentences. The cards containing the sentences were shuffled thoroughly before each testing session began, and sentences were presented in random order. Subjects were given one card at a time, and asked to read out loud the sentence written there. Breaks were allowed if subjects seemed fatigued, and positive comments only were made throughout. All subjects completed the test in one session.

Unlike Snowling and Frith's (1986) study, the subjects in this experiment were not alerted to the special status of the homographs. No teaching was given, and it was assumed from the reading ability and vocabulary level of the subjects that both uses of each target word were known. This assumption, although questionable, was necessary, since the experimenter aimed to avoid directing the subjects in any way. Nothing occurred during testing to suggest that the assumption was incorrect. None of the subjects remarked on the special status of the homographs at pretest, and comments during testing suggested that the experimenter's lack of intervention was largely successful, and that subjects treated the task as an open-ended one where the request to read out loud was not seen as unnatural. Reading errors other than on the homograph were corrected on-line by the experimenter, to ensure that comprehension of the text was possible. Such assistance was necessary for only one of the autistic subjects, who mispronounced "Lucy" as "lucky". Most of the normal children, by contrast, required correction on at least one word. Thus, although reading age was not assessed in this study (as it was in Snowling and Frith, 1986) the occurrence of reading errors and the rate of reading appeared to the experimenter to indicate that the autistic subjects were more fluent readers than the normal children.

Pronunciation of the homographs was marked by the experimenter on a standard scoring sheet. Subjects who corrected themselves were scored on their corrected attempt, although all attempts were recorded. A score out of twenty resulted (ie. out of five for each of the four conditions).

Results

The results from the homograph task can be seen in tables 8.2 and 8.3. Individual data can be found in appendix IV.

Table 8.2

Results from Homograph task: Number of words pronounced "correctly"
Group means (S.D.) Max=5

GROUP	FREQ. BEFORE	RARE BEFORE	FREQ. AFTER	RARE AFTER
Controls (n=13)	3.62 (1.19)	1.92 (1.32)	5.00 (0.00)	4.62 (0.65)
All Autistics (n=16)	4.5 (0.73)	2.75 (1.65)	4.63 (0.72)	3.38 (1.50)

A 2-way ANOVA with repeated measures (where frequency and context were the within subjects factors), comparing all the autistics as a group with the young normal controls, gave the following results:

<u>Source</u>	<u>df</u>	<u>F value</u>	<u>Tail Prob.</u>
Group	1, 27	0.01	0.932
Context		102.73	0.000
Frequency		27.59	0.000
Context by Group		48.80	0.000
Frequency by Group		0.91	0.348
Context by Frequency		9.48	0.005
Group by Context by Frequency		1.89	0.180

The ANOVA shows that the autistics and controls were indeed matched on total score, since the effect of group alone is not significant. Frequency of correct pronunciation has a significant and similar effect on both groups. However, the effect of position of context is not the same for both groups - shown in the significant interaction of group with context. This is the result predicted - that the normal children would show a significantly greater benefit from context preceding the target homograph (see fig.8.1).

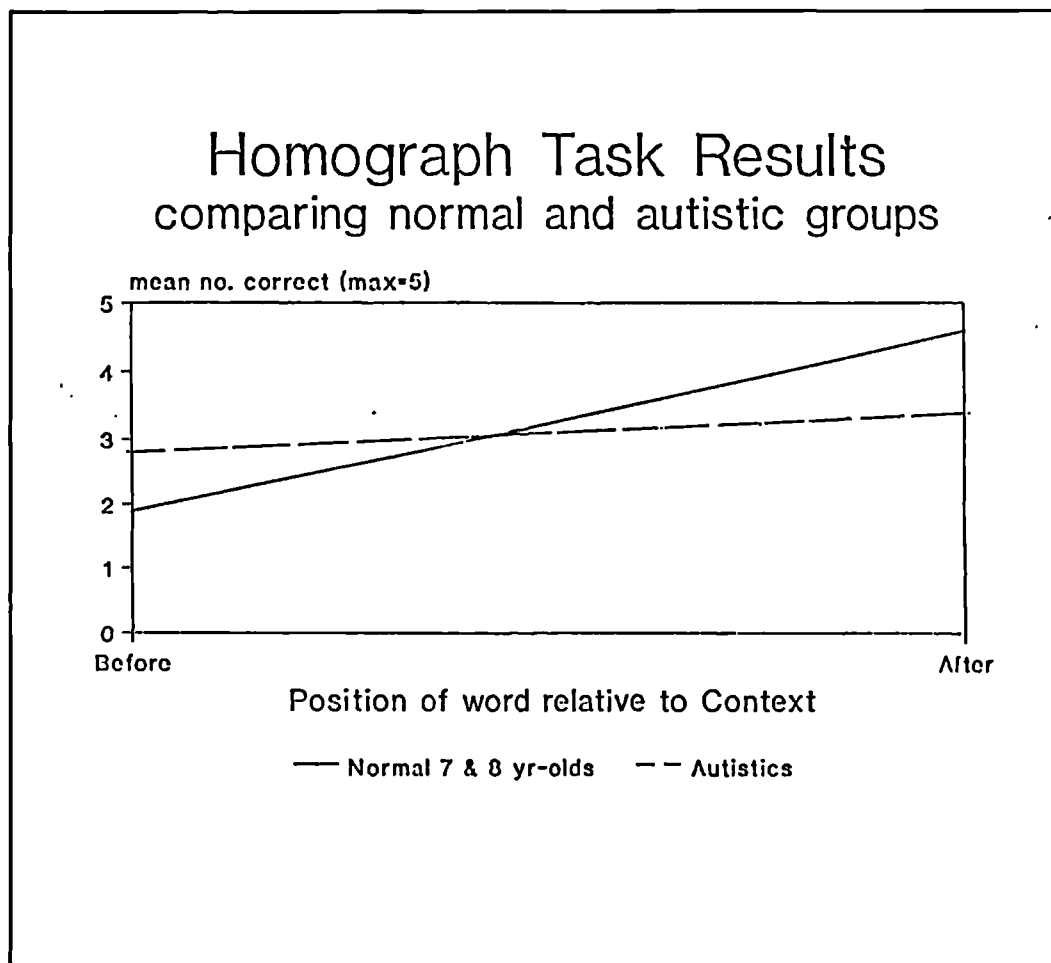


Figure 8.1 Homograph task results: comparing normal and autistic groups

This finding replicates Frith and Snowling's (1983) result, that autistic readers make less use of context to inform pronunciation than do normal readers. The finding of greatest interest, however, concerns those autistic people with good theory of mind performance. These subjects were more able than Frith and Snowling's subjects, and so might be expected to show better "reading for meaning" skills. In

addition, the findings from the relevance battery might lead us to expect that these subjects are simply better at everything. The prediction from chapter 7, however, is that even these subjects will show an impairment in central coherence, which should manifest itself in poor use of context in this reading task.

The results in table 8.3 show how the autistic subjects performed, grouped by theory of mind performance. As can be seen graphically in figure 8.2, all three groups of autistic subjects showed little benefit from preceding context. This is true even for those autistic subjects who passed second-order theory of mind tasks, who passed all tests previously reported here.

Table 8.3

Results from Homograph task
Autistic subjects grouped by theory of mind performance
Group means (S.D.)

GROUP	FREQ. BEFORE	RARE BEFORE	FREQ AFTER	RARE AFTER
CONTROLS	3.62 (1.19)	1.92 (1.32)	5.00 (0.0)	4.62 (0.65)
No ToM AUTISTICS	4.40 (0.55)	2.00 (1.87)	5.00 (0.0)	2.80 (1.30)
1st ToM AUTISTICS	4.00 (1.0)	3.00 (1.58)	4.00 (1.0)	3.60 (1.52)
2nd ToM AUTISTICS	5.00 (0.0)	3.17 (1.60)	4.83 (0.41)	3.67 (1.75)

ANOVA: Effect of context interacts with subject group in ANOVAs comparing:
 No ToM autistics and controls ($F(1,16)=12.89$; $p<0.002$);
 1st-order ToM autistics and controls ($F(1,16)=20.47$; $p<0.000$);
 2nd-order ToM autistics and controls ($F(1,17)=26.98$; $p<0.000$).

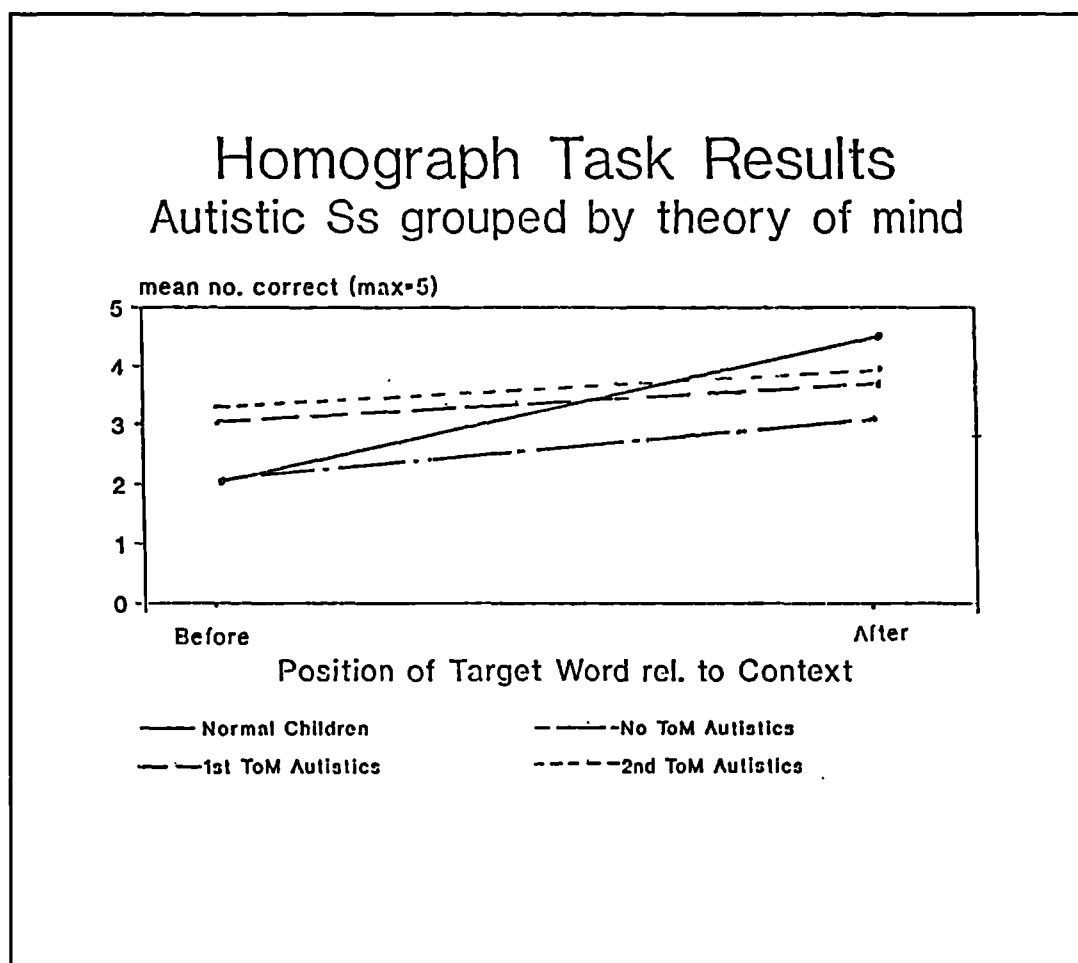


Figure 8.2 Homograph task results: autistic subjects grouped by theory of mind

What was true of the autistic group as a whole is also true for each of the three subgroups of autistic subjects grouped by theory of mind performance; autistic subjects are less facilitated than young normals by preceding context in the homograph pronunciation task. So, while the young normal subjects pronounced the homographs according to context, the autistic subjects (of all theory of mind levels) pronounced the homographs according to frequency in isolation.

Discussion

The finding that most of the able autistic subjects tested, including those who passed theory of mind tasks, failed to use context to inform pronunciation of a

homograph is very striking. While reading rate was not measured, the experimenter's impression was that most of the autistics read quite fluently, and overall at a faster rate than the normal young controls. Despite this, they did not seem to integrate the sentence context to arrive at the correct interpretation of the homographs. Very striking in the autistics' and controls' performance was the difference in degree of self-correction. While (across the four conditions) 73% of the normal children who made any errors self-corrected at least once, only 50.5% of the autistic subjects who performed below ceiling and so could have corrected themselves, did so. While the relative lack of self-correction might have been interpreted as indicating that autistic subjects' problems with this task spring from a lack of theory of mind, and hence a failure to monitor output to make the sentence comprehensible for the listener, the finding that even the "second-order theory of mind" group showed characteristic failure to use context suggests that this poor performance results from a distinct cognitive deficit. In addition, taking a "strict" score (that is, scoring on first attempt and not accepting self-corrections) still led to a significant group by context interaction ($F(1,28)=5.69$, $p<0.024$). Thus the difference between the autistics and the normals in the use of context is not solely due to a different degree of self-correction.

The findings in the experiment reported here are in accord with Frith and Snowling's (1983) finding that autistic hyperlexics fail to read for meaning. However, the results do not fit as well with these authors' later study. In Snowling and Frith's (1986) second study, hyperlexic readers without autism were tested, to explore the specificity of the failure to read for meaning. Results were analysed separately for subjects with high or low verbal ability, and showed that normal, mentally retarded and autistic subjects in the high ability group performed equally well, while low ability subjects in both clinical groups showed a failure to use context. The authors concluded that "the handicapped children whose MA was above 7 years were able to disambiguate meanings by using sentence context" and that the failure of the less able subjects was "not an autism specific phenomenon". The results of the experiment reported here would seem to suggest that even autistic people with near-normal verbal IQ fail to use context to extract meaning in this task. Of the "second-order theory of mind" group, all but one subject (187) had a VIQ of 90 or above (WISC-R or WAIS). It is hard to know why Snowling and

Frith's result should be so different from that found here. It may be that their teaching and instruction - which was intended to make available for the subjects both word meanings - made the subjects highly aware of the homograph status of the target words, and made the task less open-ended, leading those autistic subjects who were able to read for meaning to do so. It will obviously be important to replicate the present finding, and to test non-autistic mentally handicapped controls.

In line with the discussion of central coherence in chapter 7, the present results may be taken as an indication of the autistic impairment in extracting meaning in context. In this way, the results on this homograph task can be related to those studies which have found that autistic subjects benefit significantly less from meaning in memory tasks (see chapter 7, p.171). It is interesting to note, also, that the results here echo a comment by Kanner (1943), who wrote of his cases that "reading skill is acquired quickly, but the children read monotonously and a story or moving picture is experienced as unrelated portions rather than in its coherent totality".

The present finding has interesting implications for our theories of autism. In chapter 7, a deficit in central coherence was proposed as a pervasive and ubiquitous cognitive handicap in autism. The results from this task suggest something about the relation between this deficit and most autistic subjects' failure to acquire a theory of mind. Since some subjects tested here performed well on even second-order theory of mind tests, and showed similar success in understanding the intentions behind metaphorical and ironic utterances, and yet failed to use context in this homograph task, the results would appear to suggest that a deficit in central coherence can co-exist with a degree of theory of mind competence. This makes it unlikely that the theory of mind deficit is merely a manifestation of a failure in coherence at high levels, either on-line or developmentally. In chapter 9 the possible relations between theory of mind and central coherence will be discussed further.

Chapter 9

Future Directions

In this final chapter, the implications of the studies presented in this thesis are discussed in relation to Asperger's syndrome, theory of mind and central coherence. The suggestion is made that there exists a valid subgroup of autistic individuals characterised at the behavioural level by better communicative and social understanding, and distinguished at the cognitive level by the ability to represent mental states. The continuing real-life social handicaps of this "talented minority" are then addressed, and possible explanations suggested in terms of delayed acquisition of theory of mind and in terms of a continuing deficit in central coherence. The nature of the relationship between theory of mind impairments and deficits in central coherence is then considered. A causal model of the effects of a deficit in central coherence on memory, attention and the calculation of relevance, is presented. Predictions from this model provide the focus for a discussion of relevant work to date, and of possible research for the future. These suggestions form a research proposal for the formation of a battery of tests, which would allow a clearer definition of the concept of central coherence, an exploration of its relationship to theory of mind, and its role in cognitive disorders other than autism.

Introduction

The results of the theory of mind battery study suggest that while some autistic subjects have simply "hacked out" a solution to certain theory of mind tasks (a strategy revealed in their inconsistent performance), others perform consistently well across different versions of such tasks at second- and/or first-order levels. These subjects also show a level of communicative competence (in the relevance battery study) which is consistent with their theory of mind task performance. This suggests that there exists a subgroup of autistic individuals who do possess some "real" theory of mind ability. The fact that this subgroup did not differ on full

scale IQ from those autistic subjects who failed the theory of mind tasks, also argues against an explanation of this "talented minority's" success in terms of non-theory of mind strategies.

In chapter 2 it was argued that the diagnosis of Asperger's syndrome should be theoretically-motivated, in terms of underlying qualitative differences at the cognitive level, rather than quantitative differences at the behavioural level. The suggestion was made that the theory of mind deficit hypothesis of autism is a useful theoretical framework for making such distinctions. The finding that in a subgroup of autistic people social and communicative competence covary (due - it is suggested - to the common reliance of these skills on the ability to represent mental states), suggests that a real and distinct subgroup exists. This subgroup appears to be distinct not in the sense of simply being better (in terms of general factors such as IQ or sociability), but rather in the sense of being interestingly different at the cognitive level, possessing some ability that other autistic subjects lack. I suggest that this subgroup deserves the label "Asperger's syndrome". As is discussed below, a subgroup distinguished in terms of theory of mind ability may have an interestingly distinct prognosis, course and set of management characteristics.

Understanding the handicap in Asperger's syndrome

If a "talented minority" of autistic subjects (those we might label as having "Asperger's syndrome") possesses real theory of mind ability, what is the explanation for this group's undeniable handicaps? At least two possible answers present themselves, from the work reported here. The first is to posit a delay in acquiring theory of mind, and to explain the handicaps as "scars" left by the early period of inability to represent mental states. The second is to assume that these individuals developed the ability to represent mental states at the normal age, but are prevented from making flexible use of this ability by a deficit in central coherence. These two possibilities are discussed below, but it is important to note that the two are not incompatible, and that evidence to decide between them is not at present available.

No subject was found in the course of testing who passed theory of mind tasks at their CA- or MA-appropriate level. Therefore, the results do not exclude a delay hypothesis - although a longitudinal study would be necessary to explore this possibility. "Asperger's syndrome" might be used to refer to those people who gain the ability to attribute independent mental states after a significant and damaging delay. Like other autistic people, they lack theory of mind in their early years, and hence fail to develop normal social interaction, and normal perception and expression of internal states. An early deficit in attributing mental states, may affect the development of other cognitive systems. There has been some suggestion in the recent literature, that normal infants possess an ability to "perceive" intention (Premack, 1990; Dasser, Ulbaek & Premack, 1989). This ability might not develop and mature normally in the autistic child, in the absence of representations of mental states (representations which may have an important role in "tuning" this perception of intention). After some delay - due perhaps to slow maturation of a present but faulty brain mechanism - some autistic people do develop a theory of mind not unlike a normal child's. This ability however will have missed its "critical period" and be too late to inform or "tune up" the various perceptual and cognitive systems that develop alongside theory of mind in the young child. The Asperger's syndrome person's theory of mind, then, will not be useful in the normal way; it will allow them to pass tests where vital elements are made unnaturally salient, but it will not allow them to solve the more subtle theory of mind problems encountered in real life. They will fail to apply their hard-won theory of mind skills in real life because the module responsible for forming representations of mental states does not get "switched on" as it should because the perceptual system has not been "tuned" to be sensitive to displays of intention and mental states (ostention).

Asperger's syndrome people, then, would still show characteristic (if milder) autistic social impairments in everyday life, despite "real" success on theory of mind tests. They would, however, have a better prognosis, and the type of skills they would need to be taught would be meaningfully different from those required by other autistic people (who lack theory of mind). Communication would be better in these individuals with Asperger's syndrome - although a similar discrepancy between test performance and real-life competence might be expected. The high incidence of

special interests in this group might be due, in part, to better ability to tell people about their interests, and a greater desire to fit in (leading, for example, to an interest in types of carrot rather than in spinning and twiddling lids).

The higher incidence of psychiatric disorders in this group (Tantam, 1986; Szatmari, Bartolucci & Bremner, 1989) would be well explained by this hypothesis. Depression would be more common since Asperger's syndrome people have greater insight into their own deficiencies and their own feelings and thoughts. Positive symptoms of psychosis, such as hallucinations and delusions would be found *only* in Asperger's syndrome cases, by this account if one takes Frith and Frith's (1991) view of these symptoms as resulting from an aberrantly over-active theory of mind. Asperger's syndrome people, who gain theory of mind late and therefore oddly, may run a high risk of having their theory of mind "go wrong". On this hypothesis it would be impossible for a Kanner-type autistic person (who has no theory of mind) to show such positive symptoms. In this sense (according to Frith & Frith's theory) Asperger's syndrome would be something of a midpoint between autism and schizophrenia; while the former is due to a lack of attribution of mental states, and the latter due to overactive attribution, Asperger's syndrome may show both the scars of early lack of theory of mind and the florid symptoms of late acquired theory of mind working abnormally hard.

Such a theory of mind definition of Asperger's syndrome would lead us to expect that a change from a Kanner-type infancy to an Asperger-type adulthood does occur (as Wing, 1981a, has claimed), and should not be ruled out by diagnostic criteria. While, by this argument, Asperger's syndrome would be a subtype of autism, it would be a qualitatively distinct subtype, and one with distinct course, prognosis and educational needs. Asperger's syndrome would be a type of more able autism, but would not be distinguished simply by IQ. Verbal IQ (as assessed by tests sensitive to communicative/pragmatic competence, and even perhaps vocabulary measures, see chapter 6) would by definition be better in these subjects than in other autistics, but would be good only relative to general ability. It would be an empirical question whether an Asperger's syndrome picture (ie. late theory of mind acquisition) could emerge in relatively mentally retarded as well as relatively bright autistics. This question should not be pre-empted by diagnostic criteria (cf chapter

2). Asperger's syndrome would be, in short, a diagnosis reserved for autistic people who are relatively able in terms of social and communicative skills, and not just for the "more able autistic person" in general

The above suggestion for the use of the "Asperger's syndrome" label is speculative and motivated by theoretical rather than clinical distinctions. However, it is interesting to note that the 6 autistic subjects who passed second-order theory of mind tasks not only performed better on VIQ tests than those who failed, but were also more likely to have better verbal than performance skills (as tested by the WAIS or WISC-R). In general, autistic subjects tend to show a superior score on performance versus verbal subscales of intelligence tests (Lockyer & Rutter, 1970). That half the autistic subjects who passed all theory of mind tasks showed the opposite pattern (with discrepancies of between 8 and 16 points) suggests that the IQ test profile for Asperger's syndrome (as defined above) may be different from that typically associated with Kanner-type autism.

Table 9.1
Numbers of Autistic Subjects with VIQ - PIQ discrepancies
Grouped by theory of mind task performance

Theory of mind Group	VIQ>PIQ	VIQ=PIQ	PIQ>VIQ
No ToM Autistics	1	0	5
1st ToM Autistics	1	1	4
2nd ToM Autistics	3	0	3

Possible relations between central coherence and theory of mind

The findings presented in the foregoing chapters suggest that individuals can be found who have intact theory of mind ability but deficient central coherence. What does this imply for the possible logical relations between these two impairments?

In answering this question a number of levels of analysis must be borne in mind. In chapter 1 a distinction was emphasised between the biological, cognitive and behavioural levels of analysis, in discussing the cause and character of autism.

Here, levels of causal analysis can usefully be distinguished in terms of 3 timescales: the timescale of evolutionary causation, the timescale of developmental causation, and the timescale of moment-to-moment (processing) causation. In discussing the relations between impairments in central coherence and in theory of mind, the latter two levels must be kept separate.

The finding that, at the time of testing, some autistic subjects failed central coherence tasks but passed the theory of mind battery tests, suggests that the two deficits are not causally linked in moment-to-moment processing. In other words, the central coherence impairment alone does not seem to cause failure on theory of mind tasks, and theory of mind failure is not necessary for central coherence impairment. This would appear to contradict Frith's (1989a) suggestion that the theory of mind deficit is simply a manifestation of the central coherence deficit. Frith seems to have thought of the central coherence deficit as the cause of the theory of mind deficit both moment-to-moment and developmentally. Until a delay hypothesis is ruled out, the possibility remains that the central coherence deficit causes the theory of mind failure developmentally, but one would then need to posit some modifying factor that allows a subgroup of autistic people to develop theory of mind ability in the continuing presence of the original developmental cause of the deficit (the central coherence impairment).

The claim that even autistic individuals who pass theory of mind tasks show impairments in central coherence must, however, be modified by two caveats. First, the pervasive lack of central coherence is hypothesised on the basis of only one task. This is important because that one task, the homograph-reading task, was not designed to reveal degrees of impairment in extracting meaning. The possibility remains, therefore, that those autistic people who pass theory of mind tasks are in fact less impaired in terms of central coherence than those who fail. If this were the case, one might retain the central coherence deficit as the cause of the theory of mind impairment. This is in fact a quite attractive notion - that those subjects who manage to pass our theory of mind tasks are distinguished by less severe central coherence deficits. This leads us to the second of the two caveats: autistic subjects who pass the theory of mind battery may not understand mental states in their everyday lives. These subjects, then, might have just enough central coherence

to pass tests of theory of mind where elements are spelt out and decontextualised, but not enough to attribute the appropriate mental states in real-life situations. Similarly, they would perform worse on theory of mind tasks the more contextualised the tasks were - explaining the greater difficulty of the Strange Stories compared with the theory of mind battery tasks for all autistic subjects. However, in this account the theory of mind deficit has receded in importance to become merely a manifestation of the central coherence deficit. The theory of mind deficit would not, then, be a primary causal factor, but simply one among many effects of a lack of central coherence. The logical extension of this idea (extended from those subjects who pass theory of mind tasks to those who fail) would suggest that most autistic people fail theory of mind tasks simply due to a lack of central coherence. It is not at all clear that this suggestion can hold - it would predict, for example, that if you removed all elements of context and coherence from a theory of mind task, all autistic subjects would pass it. An attempt to explain autistic subjects' failure on theory of mind tasks in terms of a lack of central coherence falls foul of the same criticisms as the methodological explanations of autistic failure discussed in chapter 1. So, for example, it would be hard to argue that the Sally-Ann false belief task made greater demands on central coherence than Zaitchik's (1990) false photograph task (which most autistic subjects pass; Leekam & Perner, in press; Leslie & Thaiss, in press).

It seems, then, that the theory of mind deficit must be retained as a separate impairment in those autistic people who fail the usual theory of mind tasks. The subgroup who pass all such tasks consistently, however, may show a pattern of impairments in other tasks that is explicable by appeal to the notion of central coherence. If theory of mind ability is thought to be reliant on a modular mechanism - as Leslie (1988) has suggested - how might a lack of central coherence affect the workings of such a module? There cannot be a module for our theories about the mind or folk psychologies, but there might be a module for the representation of mental states. Its output to central processes would be representations of propositional attitudes, but what would its input be? Such a module would presumably take as the most basic input certain perceptual features which signal the use of ostention. This is how direct perception of intention might come about, with the module being triggered by perceptual features (eg. certain

patterns of movement, eye contact, speech). However, it is hard to imagine that the content of mental states could be directly perceived from perceptual features, at least in more complex cases such as beliefs. In these cases, presumably, the input to the module would have to be complex situational information. So, the idea of a module responsible for the representation of mental states implies the possibility for relatively preprocessed, complex and constructed contextual information. It may be in the construction of such input that the person with Asperger's syndrome fails.

If it were the case that a subgroup of autistic people (those with Asperger's syndrome) possessed an intact module for representing mental states, but lacked the central coherence to construct the appropriate processing context to input this module, a number of things would follow. The module should, on this simple account, respond normally to simple, direct perceptual input. Therefore the prediction would be that such individuals, as infants, would orient normally to ostention (but see below for more general attentional problems). This might in turn allow relatively non-delayed language acquisition. Impairments might exist, however, in responding to certain types of perceptual inputs which require processing of the whole configuration rather than individual elements (eg. certain complex nonverbal expressions). Such people would succeed on theory of mind tasks whenever the salient elements (eg. a character's informational access) are picked out for the subject. So, for example, in the theory of mind battery tasks the subjects were given the individual items of information, such as whether X saw/heard Y (at least through the use of individual comprehension check questions). Effectively, then, the experimenter may be removing the usual context of the scenarios and replacing it with individual elements which can be fed into the module responsible for producing a representation of the character's mental state. Where this decontextualisation is not done, this subgroup of autistic subjects will fail to attribute mental states correctly - hence their poorer performance on the Strange Stories (where elements of the stories are not spelt out along the way) and impaired real-life social adaptation.

At the moment there is little empirical evidence to decide between an explanation of the Asperger's syndrome individual's problems in terms of a pure central

coherence deficit, or in terms of an additional delay in acquiring theory of mind. Longitudinal data would be required to help decide this question, and in particular one needs to know about the presence/absence of delay in acquiring language and in attending to ostensive stimuli. One effect of a pervasive impairment in central coherence in autism would be to make "hacking out" a solution to theory of mind tasks particularly difficult. In fact, one prediction might be that - if there are degrees of central coherence impairment in autism - it will be those autistic people who perform inconsistently (suggesting the use of non-theory of mind strategies) who will be least impaired in central coherence, revealed by these subjects' ability to attempt some form of hacking.

Continuous and discrete impairments

A common question regarding autism, and in particular Asperger's syndrome, is whether we are all more or less autistic - is there a continuum on which autistic people are simply "more" rather than different? At the behavioural level, the answer is probably yes, although even here the covariation of the three core impairments is probably unique to autism. Whether or not a pattern can be distinguished at the behavioural level (where noise is introduced by multiple modifying factors), the theory of mind hypothesis has been useful in suggesting a quite distinct impairment at the cognitive level. Does the argument above - that Asperger's syndrome represents a case of autism without pervasive lack of theory of mind - weaken this strong position?

The ability to represent mental states would seem to be a fairly all-or-nothing capacity. That is, this basic ability (to represent propositional attitudes) seems to emerge universally and within a short period of time throughout the normal population. Of course normal individuals vary in their social competence, but this continuum at the behavioural level is unlikely to be due to individual differences in the basic ability to "know that we know". One might hypothesise, then, that this basic ability does not vary in the normal gene pool, and that it can only be knocked out through damage to the brain. This damage may affect the ability to represent mental states in a number of different ways; the ability may be lost

altogether, it may be late in maturing/becoming functional, it may be sluggish in its processing of information, or it may be present but aberrant in its working. In the majority of autistic people one may hypothesise the simplest sort of deficit - that the mechanism responsible for representing mental states is absent. Subgroups may emerge, however, which are distinguishable in terms of the type of deficit - a subgroup, for example, in which mental state representations can be formed only very slowly, leading to problems of social adaptation in everyday life. Asperger's syndrome may turn out to be a disorder distinguished by the type of theory of mind damage (eg. normal but very late maturing ability) - although above the more parsimonious suggestion of no deficit has also been discussed. Yet another subgroup may emerge with active but aberrant representation of mental states - perhaps the true childhood schizophrenics. However, the ability to represent mental states would still be an all-or-nothing capacity to the extent that any variation in this ability represents a deficit rather than merely a point on the normal continuum.

By contrast, central coherence may vary within the normal population. Unlike the ability to represent mental states - which is of absolute evolutionary value - different degrees of central coherence may confer evolutionary advantages in different circumstances or on different tasks. Therefore one might imagine something like a normal distribution in the population (and in the gene pool?) of the relative preference for global versus local coherence (see the discussion of field dependence below for possible evidence of such normal variation). In this case, very low degrees of central coherence will sometimes occur by chance variation alone. Where this occurs in the absence of any handicap, the result may be something like the so-called "right hemisphere learning disabilities" discussed in chapter 2. However, where brain damage also occurs and affects the ability to represent mental states, autism will occur. In these cases the unlucky co-occurrence of low central coherence and lack of mental state representation, will leave the individual with little chance of "hacking out" a solution to the puzzle of social interaction. In Asperger's syndrome low central coherence may co-occur with delayed maturation of the mechanism responsible for representing mental states.

Thinking about central coherence as a feature which varies in the normal population may have interesting implications for the idea of an extended phenotype in the

relatives of autistic people. One might hypothesise that the hereditary contribution to autism lies purely in genes for a tendency toward local versus global processing of stimuli. This suggestion has the virtue of making clear predictions about the patterns of cognitive deficits reported to occur in the siblings of autistics: they should be deficits which follow from a lack of central coherence.

This section has raised many questions and answered few. That is, perhaps, inevitable at this early stage in the investigation of these issues. Progress in answering these questions will only be made with the aid of empirical studies exploring the patterns of co-occurring and dissociating deficits in representing mental states and in extracting context-dependent meaning. In the next section, a causal model is presented which makes clear predictions about the effects of a deficit in central coherence. Each of these predictions is examined in turn, relevant data is reviewed and suggestions are made for future studies. Two areas of research outside the study of autism are then discussed, to demonstrate how exploring the patterns of co-occurring deficits may shed light on the nature and effects of variations in central coherence.

Central Coherence: Predictions, existing findings and suggested studies

Figure 9.1 shows a causal model of the effects of a deficit in central coherence (solid arrows indicate effects at the behavioural level). The deficit in central coherence is itself hypothesised to be a direct result of the deficit at the level of the brain/biology. From Frith's (1989a) analysis, weak central coherence is seen as causing directly the stereotypies, skill at Block Design and the Embedded Figures Test, and some of the savant phenomena. So, for example, if central coherence is weak, information will only be drawn together within very restricted domains. So, while the idiot savant who calculates prime numbers is obviously capable of inferring and extracting meaning within the realm of that calculation, he may be unable to pull together more diverse information. Or, as in the cases of many calendrical calculators, even these mathematical skills may be circumscribed in their use. Those autistics who can calculate the day of the week from the date are often

found to have difficulty with simple arithmetic, finding even multiplication and long division impossible (O'Connor, 1989). Such findings suggest parallels with the notion of modularisation (Karmiloff-Smith, 1986) - since in Fodor's (1983) conceptualisation only the output and not the intermediate representations are available to conscious access in modular processes. The relation of the central coherence notion to the concept of modularisation is discussed further below.

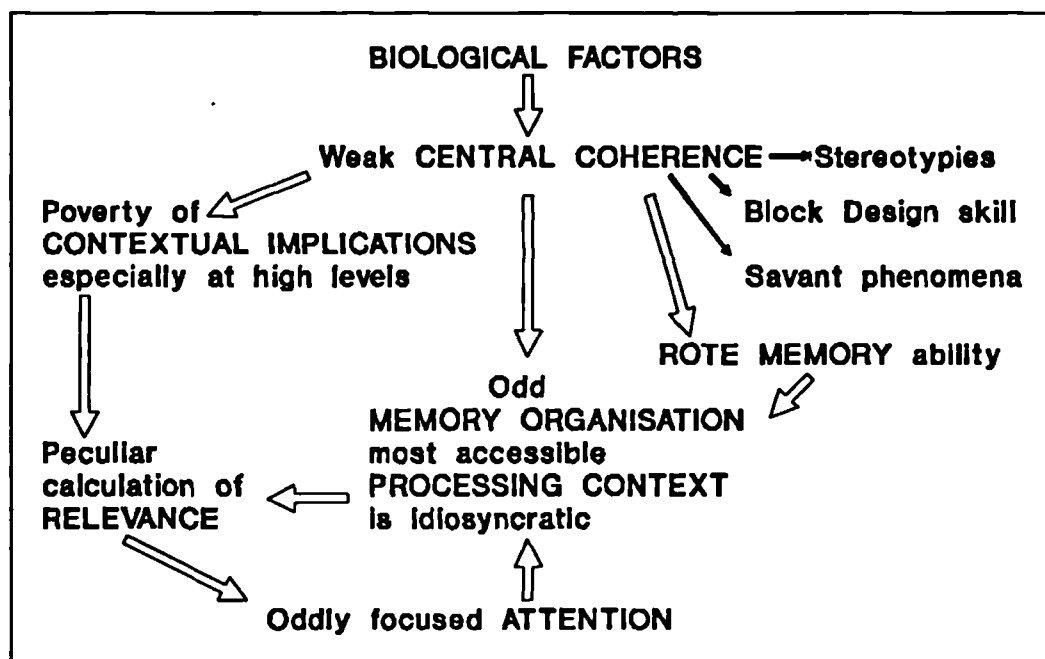


Figure 9.1 A causal model of the effects of a deficit in central coherence on the calculation of relevance

In chapter 7 the effects of a deficit in central coherence were discussed in terms of the contextual implications and processing costs which are assessed and compared in the calculation of relevance (cf p.174-176). Figure 9.1 shows these effects schematically, and makes clear the predictions that follow from this extension of Frith's (1989a) hypothesis of weak central coherence in autism. The causal model (figure 9.1) makes the following predictions:

Prediction 1

Stereotypes, savant skills, and islets of ability such as success at Block Design and the Embedded Figures Test, all spring from the autistic child's lack of central coherence (Frith, 1989a). If this is the case, these features of autism should hang together within individuals. If these features also occur in non-autistic individuals, they should either be qualitatively different in some respect (if caused by something other than weak coherence), or they should appear together with other manifestations of a deficit in central coherence.

Existing findings: There is no work to date examining the co-occurrence within autistic individuals of the various abilities and handicaps hypothesised to spring from a lack of central coherence. Research into other disorders, such as right hemisphere damage, frontal lobe syndromes, or semantic pragmatic disorder may hold clues to the existence of deficits in central coherence in non-autistic populations. The pattern of impairments in right hemisphere disorders and, in normal subjects, the co-occurrence of certain abilities examined within the "field-dependence" literature, are discussed below.

Future studies: Exploration of the central coherence hypothesis requires the development of a battery of tasks, administered across a range of experimental and control groups. Correlations between measures hypothesised to tap central coherence could then be examined, and relations to level of everyday functioning could be explored. Degree of impairment in central coherence could also be assessed, which might be of importance in exploring the nature of Asperger's syndrome. Some tasks that might be included in a test battery for central coherence are suggested below.

Prediction 2

Superior rote memory ability may be a direct behavioural manifestation of the effects of weak central coherence on the developing cognitive architecture. The central coherence hypothesis would predict that where rote memory alone can be used (ie. where extracting gist cannot be done) autistic memory will exceed that of controls.

Existing findings: In the studies discussed in chapter 7 there was some indication that autistic subjects' rote memory for material might exceed that of controls. The autistic subjects in Hermelin and O'Connor's (1967) test of serial recall of sentences and word strings, scored more highly than the controls on recall of both infrequent-word sentences and random word strings. This finding gives some support to the suggestion that autistic rote memory may actually be better than "normal" (ie. than MA- or IQ-matched controls). However, in most cases controls will struggle to attribute meaning to material, and where such meaning aids recall the better rote memory of the autistics may be obscured. This may explain why recall is not always better in autistic subjects. In addition, in some of the studies reviewed in chapter 7 (eg. Aurnhammer-Frith, 1969; Hermelin and O'Connor, 1967; O'Connor and Hermelin, 1967) the subjects and controls were matched on digit span. Since digit span may well be a test of pure rote memory ability, matching controls in this way would obscure possible group differences in memory for meaningless material. These studies, then, do not address the issue of whether rote memory itself is better than would be predicted (on the basis of IQ or MA) in autistic subjects.

Although it cannot be taken as empirical evidence, it is interesting to note Kanner's (1943) impressions of "excellent rote memory" in his patients, who memorised at an early age "verses, zoologic and botanic names, titles and composers". He was struck, in particular, by the lack of meaning in what the children memorised; "To a child two or three years old, all these words, numbers and poems ("Questions and answers of the Presbyterian Catechism"; "Mendelssohn's violin concertos"; the "Twenty-third Psalm"; a French lullaby; an encyclopedia index page) could hardly have more meaning than sets of nonsense syllables to adults".

Future studies: Autistic memory for nonsense should exceed that of controls, as long as they are not matched already for digit span. Digit span itself should be higher in autistics than in control subjects matched on IQ or MA measures. Autistic subjects should be more accurate in recalling nonsense materials, and less prone to making errors towards meaning, or "restructuring" for coherence in recall (Bartlett, 1932), than normal or mentally handicapped subjects. Autistic subjects may also be less affected by semantic similarity of to-be-remembered items in tests

of delayed recall than are controls, while being affected as normal by phonological similarity on immediate memory tests (and perhaps even after long delay, unlike normals; Baddeley, 1966). These predictions also relate to the hypothesised failure to extract gist (prediction 3, below).

Prediction 3

Autistic people of all ages and abilities should be impaired at extracting contextual implications and context-dependent meaning (cf p.174).

Existing findings: The work by Frith (1970a,b), Hermelin and O'Connor (1967) and others on the failure of autistic people to use meaning to aid memory or to order stimuli, has already been discussed (chapter 7, p.169-172). It is interesting also to note that the strategy that appeared to be used by some of the autistic subjects in the second-order deception tasks (of the theory of mind battery, reported in chapter 3), involved paying attention to elements of the story in isolation rather than extracting the gist of the story as a whole (cf p.93). In addition, the results of the homograph task, reported in chapter 8, suggest that an impairment in extracting context-specific meaning may characterise even those highly able autistic subjects who succeeded on theory of mind tasks.

A quite different finding that may reflect an autism-specific impairment in pulling together diverse information to extract meaning, is reported by DeGelder, Vroomen and Van der Heide (in press), who found that autistic people showed a significantly less pronounced McGurk effect (blends and fusions in perception of a phoneme heard synchronised to a visual display of lips forming a different phoneme). This was despite their ability to "lip read" a phoneme, which matched that of the normal controls. The authors argue that this fusion effect normally occurs at a relatively peripheral stage of processing. However, the possibility exists that the paradigm of the McGurk effect may under certain conditions (eg. using real word stimuli) become a sort of Rod and Frame Test - with individual differences emerging in which source of information is privileged for disambiguating the stimulus.

Another study suggests a failure of coherence in autistic communication. Bruner and Feldman (in press) report that even able autistic adolescents gave relatively fragmented narratives in a story telling task. They report that "the story telling task seemed to evoke, in lieu of narration, a genre of description, for its more frequent words were mainly of specific elements in the story drawings - beach, castle, clouds, flower, girl, plants, pool, rain..." In one study, 4 autistic 15-year-olds of above average IQ were told fables about trickery and deceit, and asked to tell them back in their own words. The subjects did not "organise their retelling" around the salient episode; "their retellings report a sequence of actions or events seen in a story rather than composing something that is a story itself". Bruner and Feldman conclude from these findings that autistic subjects have a specific problem with constructing narratives (and that their theory of mind problems are only one manifestation of this); "an early absence in the autistic child of the normal impulse to tell narratives to himself and others, an activity that ordinarily recreates raw experience into a symbolic form that is useful for entering real life experience into discourse....the communicative problem in autism is due to a weak or absent impulse to rework life experiences into narratives". Such an impairment can be seen as just one aspect of a more general failure to search for meaning, in terms of global versus local coherence.

Again, it is interesting to note Kanner's (1943) original observations of a tendency to fragmentary processing in his cases; "a situation, a performance, a sentence is not regarded as complete if it is not made up of exactly the same elements that were present at the time the child was first confronted with it". Kanner saw as a universal feature of autism, "The inability to experience wholes without full attention to the constituent parts", a characteristic that would follow from a deficit in central coherence.

Future studies: Contextual implications and context-dependent meaning will not be constructed as well by autistic subjects as by normals. The ability to resist context should aid autistic subjects in a number of tasks, apart from the already documented ability on EFT and Block Design tests (cf p.170). For example, they should not show the false positive recognition of a prototype following exposure to exemplars, which normal adults show (Franks and Bransford, 1971). They may also

be better at spotting certain sorts of "errors", which normal subjects miss due to paying preferential attention to the meaning of the whole - for example spotting that the "H" and "A" below are in fact identical;

THE CAT

By contrast, the inability to use context will cause autistic subjects to perform poorly in certain tasks, where the correct interpretation of an ambiguous stimulus depends on its meaning in context. So, for example, ambiguous shapes in a line-drawing may not be recognised as objects appropriate for the scene (eg. a circle as a plate in a dinner table scene, as a manhole in a road scene). Palmer (1975) demonstrated the influence of prior presentation of visual scenes on the identification of briefly presented drawings of objects. Normal subjects are more likely, for example, to recognise a drawing of a loaf of bread after seeing a kitchen scene (not containing a loaf), and less likely after this scene to recognise a picture of a mailbox (of much the same shape). Autistic subjects might show less facilitation from appropriate prior context and less interference from inappropriate context.

Autistic people should also show an inability to use context to disambiguate linguistic material. The inability to process linguistic information in context could be tested with the sorts of narrative and inferencing tasks which have been given to right hemisphere patients, described below - though in some cases a deficit in theory of mind may confound failures of central coherence. Much of normal communication uses indirect utterances, and even such simple reference as in the sentence below requires coherence to establish who "he" refers to;

John can open Bill's safe. He knows the combination

Prediction 4

Autistic people will show **idiosyncratic memory organisation**, and the most accessible processing context for an autistic individual will often not be the same as for a normal person.

Existing findings: Existing work on autistic memory gives a rather confusing picture of impaired and unimpaired performance. Autistic children are said to be unimpaired (relative to MA-matched controls) at associative and cued recall (Boucher and Warrington, 1976), at immediate auditory-verbal memory (Bartak et al, 1975), and at echoic memory and the recency component of recall (Boucher, 1978). By contrast, they show impairments in auditory-verbal memory after a filled delay (Boucher and Warrington, 1976), in visual memory for faces (Boucher and Warrington, 1976), in imitation of seen movements (DeMyer, Alpern & Barton, 1972), and in memory for recent events (Boucher, 1981). Some of these impairments may well be secondary consequences of other deficits. For example, if autistic people attend to features of the environment that normal subjects would regard as irrelevant, it may be that recognition memory for complex stimuli such as faces, memory and imitation of movements (which usually contain some element of ostention), and memory for recent events would be disrupted. Perhaps the odd attention of autistic people leads to the setting up of memory traces which are relatively difficult to access in normal recall paradigms. This would fit with Boucher's (1988) suggestion that autistic memory is only deficient at the retrieval stage, a conclusion which she draws from the generally unimpaired performance of autistics in cued recall tests.

The fact that autistic subjects show fairly normal recall in response to orthographic, phonological and semantic cues (Boucher and Warrington, 1976) might seem at first glance to contradict the idea that autistic long term memory will show peculiarities of organisation (as is predicted by the central coherence hypothesis). However, only the semantic cuing effects bear on this point, and in every case these cues approximate a dictionary definition of the word to be cued. It may well be that in verbally able autistic subjects (who are usually matched with controls for VMA) the semantic store of words (or mental lexicon) contains the usual definitional knowledge in a form that approximates normal and which can be accessed as

normal - while still allowing for peculiar nondefinitional associations, concepts and episodic memories. Certainly many able autistic subjects score well on the Information subtest of the WISC/WAIS - a test of general knowledge - and on the Vocabulary subtest (Lockyer & Rutter, 1970), which suggests that semantic information of at least some sorts is normally accessible to them. The same argument applies to Boucher's (1988) results concerning verbal fluency tests. She compared 7 high functioning autistic children with CA- and vocabulary-matched mentally handicapped controls, on word fluency. While the autistic subjects were significantly poorer at generating miscellaneous words (when told simply to think of "words"), the groups did not differ in generating words in response to cues such as foods, animals and colours. Boucher interprets her findings as evidence of a retrieval deficit, arguing that autistic children can exploit within category organisation (such as the category of foods), but that "words" may be an abstract category posing special problems. Again, this study proves only that autistic subjects show normal knowledge of word meanings and object categories (also demonstrated in a study by Tager-Flusberg, 1985). What would be more informative for the hypothesis suggested here would be to look in detail at the clustering of items produced in response to the "word" cue, where degree of central coherence rather than vocabulary knowledge might be revealed.

The very peculiar responses of some of the autistic subjects to the Strange Stories (chapter 4, cf p.119/120) give an immediate impression of the autistic individual's idiosyncratic view of events. These responses appear to normal subjects to be far more ingenious and difficult to generate than the correct mental state answers, suggesting that the most accessible processing context for the autistic subject reading each story is very different from the most accessible processing context for the normal subject.

Future studies: Odd memory organisation might be probed with verbal free association tests, where norms are known for usual responses to items. Verbal fluency tests should also reveal idiosyncratic associations in memory, if the pattern and grouping of words generated is analysed. The recall clustering of semantically related items which normals show (first reported by Bousfield, 1953), also appears to be absent or peculiar in autistic subjects (Hermelin & O'Connor, 1967, see p.171

above), and this deserves further study. Communication should also show signs of the most accessible processing context being odd; autistic subjects might not assume (as normals do) that in a conversation about pets the words "big cat" mean a large pussycat, and in a conversation about big game hunting that they refer to a lion or tiger (cf. p.124). Gernsbacher and Faust (1991) have examined this sort of comprehension in normal subjects. They found individual differences in subjects' ability to reject contextually inappropriate meanings of words. "Poorer comprehenders" continue to show interference to recognition of the word "ACE" presented with a delay, after seeing the sentence "he dug with a spade", while "good comprehenders" show interference only with immediate presentation. Similarly, poor comprehenders took longer to reject the word "CALM" as appropriate to the meaning of the preceding sentence; "He had lots of patients". While the authors consider these individual differences to be due to differences in the ability to suppress irrelevant information, they also consider the possibility that subjects would show increased interference if they failed to establish the correct context. Such tasks might, then, be useful for probing autistic subjects' processing of stimuli.

Prediction 5

The relevance of stimuli as assessed by autistic and by normal people will be different. In communication this will lead to violation of the guarantee of relevance - an impression that autistic speakers are not "playing by the rules". Outside the realm of ostention, this difference will be most clearly seen in the idiosyncratic focus of autistic attention. Unlike the hypothesis presented in chapter 5 concerning the effects of a lack of theory of mind on communication, the central coherence hypothesis predicts that autistic attention will be deviant even outside the realm of ostention.

Existing findings: Most research on attention in autistic subjects has been concerned with their relative inattention to social stimuli. The central coherence hypothesis, however, predicts that attention will be peculiar in autism not merely because of a failure to privilege ostensive stimuli but because of a more generally idiosyncratic assessment of what is relevant. There is some evidence in the existing

literature that attention even to non-social and non-ostensive stimuli is disturbed in autism. For example, O'Connor and Hermelin (1967) found that a group of autistic subjects (of mean MA 6 years) spent more time than normals looking at the blank background on which were mounted the pictures of faces and patterns which they were intended to choose between. These researchers also found that rather than avoiding eye gaze, autistic children generally show very short fixations to all stimuli, and probably appear to avoid eye contact because normal subjects privilege such ostensive stimuli. However, a relative preference for a blank background rather than a geometric pattern would appear to demonstrate odd focus of attention in these autistic children outside the realm of ostensive stimuli.

Rincover and Koegel (1975) found that autistic subjects conditioned to apparently irrelevant aspects of a learning situation, such as the colour of the teacher's dress, or the room in which teaching first took place. It is not clear from this result, however, whether the autistic subjects' attention was focused oddly only in so far as they did not preferentially attend to the teacher's ostensive behaviour, or was deviant with respect to all aspects of the situation (noncommunicative as well as communicative).

Frith and Hermelin (1969) found that autistic subjects, unlike normals, found it as easy to put a jigsaw together using only the shapes of the pieces (with blank faces) as using the usual picture information. This suggests a different focus of attention in the jigsaw task - a task which involves no stimuli of an obviously ostensive nature. Shah and Frith (1983) report that the autistic subjects in their study of ability on the Embedded Figures Test used rather different strategies for finding the hidden shape in the whole. There was a trend for autistic subjects to use an "immediate" strategy (as opposed to visual or manual search) more often than controls in successful trials, and to use visual search less often than controls in incorrect responses. These results suggest that the autistic subjects may have found their attention drawn automatically to the target shape more often than did normal or mentally handicapped controls.

Another interesting result that suggests there may be problems in autistic people's attention even outside the field of communication and ostension, comes from a

study by Fein, Tinder and Waterhouse (1979). They tested 6 autistic children (aged 7 to 14 years, MA on PPVT 2.9 to 8.9 years) versus 8 CA-matched normals, on a stimulus generalisation paradigm, using simple stimuli (a line in one of 4 orientations) and complex figures (5 stick-men). No group differences were found on the simple stimuli, but overgeneralisation errors occurred on the complex figures. The authors concluded that the autistics did not over- or under-generalise per se, "but that they respond to fewer features of a stimulus than the normal children". This would explain why the autistic subjects were as good as normals at the simple stimulus task, since in this case there was little choice as to what should be the focus of attention. The theory of a deficit in central coherence presented here would make a claim similar to Fein et al's. While much of the work on attention in autism has been performed to explore the "stimulus overselectivity hypothesis" (Lovaas et al, 1971), the central coherence theory of autism would predict that what autistic failure on attention tasks actually shows is not over- (or under-) selective attention but odd selection of what to attend to. The overselectivity hypothesis floundered when it was found that a narrowing of attention was also common among non-autistic mentally handicapped subjects. The strong prediction from the central coherence hypothesis is that autistic people show a characteristic, universal and unique peculiarity in their focus of attention.

There are findings from studies not directly assessing attention which nonetheless appear to support the idea that autistic people show an idiosyncratic choice of attentional focus even outside the realm of ostension. Waterhouse and Fein (1982), for example, report that on a picture description task autistic subjects show inappropriate attention to "minor details". James and Barry (1980) report that retarded autistic subjects show a relative lack of habituation. One possible explanation for this finding would be that these subjects were attending to aspects of the stimuli that were not intended to be the focus of attention (like O'Connor and Hermelin's (1967) subjects who looked at the background rather than the test stimuli), or to irrelevant aspects that were not actually kept constant. Lastly, Klin's (1991) study of listening preferences (cf p.129) can also be seen as a study of autistic attention - with the finding that autistic subjects (unlike normals) do not choose to pay attention to meaningful stimuli (mother's speech) in preference to stimuli which appears to normal hearers to be irrelevant (the din of jumbled

speech). The apparatus used - allowing a choice between stimuli - may be useful in exploring autistic subjects' assessment of the relevance of different stimuli - since if attention is turned to what is relevant (to the individual) in the environment, the child should choose to experience (and hence attend to) the more relevant of two stimuli.

Future studies: What is relevant for an autistic person and for a normal person will often be radically different, as a result of the differences described above, which in turn alter the costs and benefits of information processing for autistic individuals. This "disagreement" as to what is relevant will be manifest in conversation, where autistic people will appear to violate the guarantee of relevance. However, as before, in communication deficits in central coherence will be confounded by problems of theory of mind. The autistic person's idiosyncratic assessment of relevance will also be manifest in their attention to apparently irrelevant aspects of the environment. This might be assessed by recording looking patterns in response to pictures, where most normal subjects show similar patterns (Yarbus, 1967), and autistic subjects might show very different patterns. Alternatively, subjects could be asked to describe pictures, as has been done with schizophrenic patients. Reich and Cutting (1982) found that schizophrenics differed from normal subjects (while depressives did not) in tending to describe minor elements of a picture (such as an object or activity) before describing "global units" such as the theme of the picture. Another method might be to use the listening preference technique devised by Klin (1991), on the basis that subjects will not only pay attention to but also choose to experience the more relevant (for them) of two stimuli.

The above predictions are inter-related, and so the tests suggested should be combined into a battery of tasks to explore the central coherence hypothesis. Performance on such tasks should be examined in relation to everyday life handicaps, which could be measured using the Vineland Adaptive Behaviour Scales (Sparrow, Balla & Cicchetti, 1984). The specificity of any impairments found would clearly have to be established, through the use of non-autistic mentally handicapped controls. The battery would be a vital tool in exploring the relationship between

deficits in central coherence and impairments in the ability to represent mental states.

The central coherence battery would also have relevance for the exploration of deficits in other clinical groups. Use of such a battery with frontal lobe and right hemisphere patients, for example, might reveal whether some or all such subjects suffer from a deficit in central coherence, or whether their pragmatic difficulties are better explained by problems in theory of mind. A deficit in central coherence may also be at the root of semantic-pragmatic disorder (p.57/58). It has yet to be established experimentally whether children exist who show pragmatic problems in the absence of deficits in theory of mind (Bishop, 1989). This has in the past seemed theoretically implausible, since an understanding of other minds has been thought of as the primary component underlying pragmatic competence (eg. Grice, 1957). However, the notion of central coherence, and its role in the assessment of relevance, suggests that a non-social handicap may affect communication, in a superficially similar way. If this is the case in semantic-pragmatic disordered children, they should also show predictable deficits in tasks not to do with communication (eg. using context in visual tasks) - taking this disorder out of the realm of pure language and communication problems.

Existing findings outside autism research

Here, two areas of research outside autism are discussed in relation to the central coherence hypothesis presented above; right hemisphere disorders, and field dependence-independence. In discussing the former body of work, the intention is not to enter into issues of localisation, but rather to explore a range of deficits which appear to relate to central coherence, and to show a degree of co-occurrence which is theoretically interesting.

Central Coherence in right hemisphere disorders

In chapter 6 right hemisphere damage was discussed in relation to pragmatic deficits. The common inability of patients with right hemisphere damage to interpret metaphorical, sarcastic, indirect and humorous utterances has been seen by

researchers in the field as demonstrating a deficit in using "linguistic information in context" and "contextual information to derive meaning" (Bryan, 1988). On the other hand, frontal lobe deficits have also been interpreted as a loss of ability to plan action in context (Shallice, 1988). These explanations of patients' difficulties clearly relate closely to the concept of central coherence. A deficit in central coherence would appear to account well for many of the pragmatic problems seen after right hemisphere damage. Several studies show that such patients have trouble in integrating the elements of a narrative: Brookshire and Nicholas (1984) report that right hemisphere patients process only direct linguistic information in a narrative, and show deficits in making inferences from the story as a whole. Wapner, Hamby and Gardner (1981) found that right hemisphere patients had specific problems with integrating elements into a coherent narrative and in "utilizing surrounding context as they assess linguistic messages". On a battery of tasks, including arranging sentences to form a story and extracting a moral from a fable, the right hemisphere patients showed a tendency to "focus on insignificant details or make tangential remarks" - which suggests that their assessment of relevance in the test situations was idiosyncratic. A specific problem in inferencing was reported by Brownell, Potter, Bihrlé and Gardner (1986), who presented right hemisphere patients with two sentences which if processed together would lead to a correct inference and if processed singly would lead to an incorrect inference being drawn. They found that patients (unlike normal subjects) tended to process the sentences singly, and in particular made errors where the first sentence presented was misleading. They conclude that the right hemisphere patients had difficulty in "revising previously acquired knowledge in the light of new information" - a process of achieving global versus local coherence. In Brownell et al's words, "Where normal listeners are concerned to weave a coherent interpretation of a narrative discourse...right hemisphere patients are often stuck with, or are satisfied with, a limited and piecemeal understanding". A similar deficit in coherence has been proposed as the cause of the failure to comprehend humour, commonly reported in these patients (Bihrlé, Brownell, Powelson & Gardner, 1986; Gardner, Ling, Flamm & Silverman, 1975; Wapner et al, 1981). Brownell, Michel, Powelson and Gardner (1983) suggest that appreciation of jokes presupposes two elements; a sensitivity to the surprise element of the punchline, and an apprehension of the coherence which results when the punchline is integrated with the body of the joke.

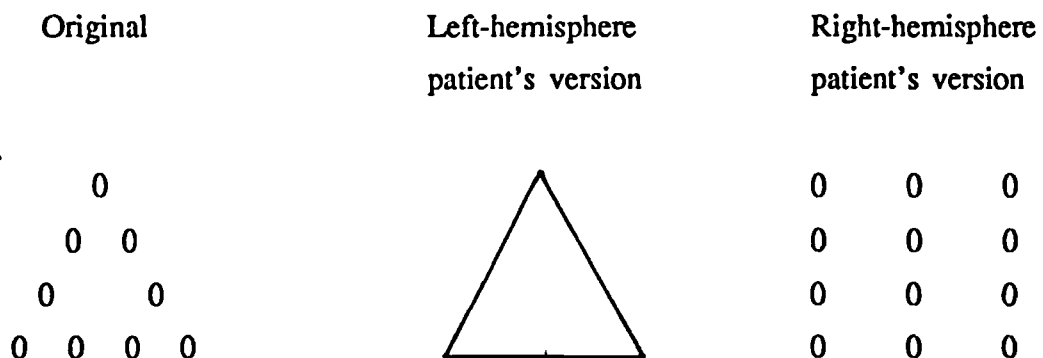
They gave subjects a choice of 4 punchlines to finish a joke, and found that right hemisphere patients showed a selective attraction to endings which contained an element of surprise but were not coherent with the body of the joke.

Suggestions in the right hemisphere damage literature that pragmatic difficulties can be accounted for by a failure to use linguistic context, have relevance for the interpretation of similar deficits in autistic subjects. As has been suggested above, it may be that the able autistic subjects who passed even second-order theory of mind tasks and yet showed problems in understanding the "Strange Stories", were handicapped not by lack of theory of mind at a still higher level, but by an inability to apply their knowledge of mental states due to a deficit in central coherence.

In addition to the work on pragmatic difficulties following right hemisphere damage - which might also be interpreted in terms of a failure of theory of mind - there exists a fairly large body of work on the spatial handicaps of these patients. This research too suggests a deficit in central coherence. In particular it is encouraging to find that failures of pragmatic use of context and failures of coherence in spatial tasks have been related. Indeed, Moya, Benowitz, Levine and Finklestein (1986) demonstrated a correlation between degree of failure to extract information from a linguistic context (a narrative passage) and degree of constructional apraxia in right hemisphere stroke patients.

There is growing evidence for some type of "global precedence" in normal perception (eg. Navon, 1977, 1981, 1991). This is demonstrated, for example, in subjects' inability to resist the global properties of a complex figure even where this distracts from the local properties which are the intended focus of attention (Hoffman, 1980; Hughes, Layton, Baird & Lester, 1984; Miller, 1981; Paquet and Merikle, 1988). This interference effect is asymmetrical, with far less interference occurring from local elements when a global judgement is required. Resistance to instructional conditions in the global precedence effect, suggests that at least some of this advantage is due to properties of basic perceptual rather than conscious attentional mechanisms. Doyon and Milner (1991) presented right and left brain damaged subjects and normals with Stroop-type tasks involving response to local or global elements of a large figure composed of similar or different smaller figures.

They found, in accord with previous studies (Lamb, Robertson & Knight, 1989; 1990) that right hemisphere patients were less affected than the other groups by interference from the global aspects of stimuli when responding to the local elements. Robertson and Lamb (1991) reviewed findings in this area, among them the deficits in drawing from memory shown by right and left hemisphere patients; while left hemisphere damage leaves patients able to reproduce the overall figure but not the elements composing it, right damage leaves a capacity to reproduce elements but not configuration (Delis, Robertson & Efron, 1986);



Similar deficits are reported in children with congenital right-hemisphere damage. Stiles and Nass (1991) observed the spontaneous play of 20 pre-schoolers with damage to the right or left hemisphere, when presented with sets of blocks. The authors conclude that "data for the children with RH injury suggested difficulty organizing objects into coherent spatial groupings, while data from the children with LH injury suggested difficulty with local relations within spatial arrays". The deficits of the right hemisphere group were persistent according to a cross-sectional study and three longitudinal case-studies.

The study of right hemisphere disorders appears to be relevant, then, to the exploration of central coherence. Issues of localisation of function are not of interest in this respect, however, and it is not the site of damage but the fact that certain deficits appear to co-occur as a result of damage that is of importance. Criticisms of a simplistic dichotomous characterisation of the functions of the hemispheres (eg. McKeever, 1981) or of disregard for developmental issues (eg. Hynd & Willis, 1988), do not, therefore, lessen the usefulness or interest of the

right hemisphere work for the present purposes. Indeed, these criticisms may be avoided by a more theory-driven analysis of the tasks patients fail, in terms of cognitive components such as theory of mind ability and central coherence.

In chapter 2, where the diagnosis of Asperger's syndrome was discussed, current clinical practice was criticised for trying to make distinctions at the behavioural level without regard to their substrates at the cognitive level. A similar danger may lie in wait for those interested in the cognitive and behavioural sequelae of brain injuries - except that the dangerous tendency here is for premature distinctions at the biological level. So, for example, it is only too easy to slip into talking about "right hemisphere disorders" or "frontal tasks" as short-hand labels for an array of very different deficits. This soon leads to an erroneous belief, at least among those not involved at first-hand with patients, that there is a consistent picture of conceptually-related deficits that can be attributed uniquely to a certain area of the brain. Such gross biological characterisations are seductive and unproductive for those interested in the cognitive workings of the brain. Breaking down the heterogeneous batteries of neuropsychological tests into sets of tasks which appear on theoretical grounds to tap the same underlying cognitive disfunction, allows a way out of the morass of localisationism. So, for example, it may be more useful to consider the cognitive mechanisms underlying so-called right-hemisphere tasks or frontal lobe batteries. If these batteries could be divided into sets of tasks thought to tap, for example, theory of mind ability, central coherence, and so on, then issues of localisation could be separated from issues of the cognitive characterisation. The co-occurrence and covariance of deficits on different tests, and their relation to the site of patients' lesions, could then be explored systematically. As with the diagnosis of Asperger's syndrome, bold theoretical strokes are necessary, accompanied by open-minded exploration of naturally-occurring clusters of deficits.

Central Coherence in normal subjects - a cognitive style?

The wide range of scores commonly attained in normal samples on the Embedded Figures Test and WISC/WAIS Block Design subtest suggests that central coherence may vary considerably even within the normal population. Indeed, the Embedded

Figures Test has been taken as a good measure of an individual difference in "cognitive style".

Witkin (Witkin, Lewis, Hertzman, Machover, Meisser & Wapner, 1954; Witkin, Dyk, Faterson, Goodenough & Karp, 1962) suggested that the EFT measured degree of "field independence". The dimension of field dependence/independence originated to cover a purely perceptual characteristic; the degree to which a subject seated in a darkened room would use gravitational cues or misleading visual cues (from a tilted frame) to judge vertical direction in space (the Rod and Frame Test; Asch and Witkin, 1948). Witkin explored the large individual differences he found on the RFT, and found a surprising degree of self-consistency within subjects across different tests (Witkin et al, 1954). The term "field dependent" was initially applied simply to people who were more affected by the visual frame information than by internal vestibular cues. However, a range of personality factors gradually emerged that were well predicted by the perceptual field dependence or independence of subjects. For example, conflict resolution in conversations between two people could be predicted on the basis of the field dependence or independence of the subjects, as assessed on the RFT or EFT (Witkin and Goodenough, 1977). On a number of measures, field dependent people emerged as relying more on external information, not only in perceptual tests but also in social situations. Field dependent people appeared to be more socially oriented, more attentive to social cues, more "open" in conversation, and to prefer greater physical proximity to others (Witkin and Goodenough, 1977). In addition, field dependence as assessed by perceptual tests such as the RFT, appears to be related to individual differences in higher-order cognitive tasks; ability on the RFT and EFT correlate with ability to solve problems (such as the Duncker problems; Duncker, 1945) which require the reorganisation of a situational context (Goodenough and Karp, 1961; Karp, 1963; Witkin et al, 1962). One particularly interesting finding, in the light of the work discussed above (and in chapter 7), is that in free recall tests, field independence and meaningfulness of items interacts - with more field independent people performing better with nonsense materials (Kazelskis, 1969). As a result of such findings, the concept of field dependence-independence has broadened from a characteristic of perceptual cue resolution to a dimension capturing the degree to

which embedding context is analysed or overcome in information processing across social, cognitive and perceptual domains (Witkin et al, 1962).

Witkin himself viewed field independence as just one manifestation of a deeper underlying individual difference in degree of "differentiation" - with the more differentiated mind being more heterogeneous, having greater specialisation of function and greater self/nonself segregation, which manifests itself in style of perception, cognition and socialisation. Like many earlier thinkers (eg. Lewin, 1935), Witkin assumed development to be a process of "differentiation" from a largely homogenous to a more heterogeneous mind. In Karmiloff-Smith's terms, such differentiation might be thought of as occurring through a process of "modularisation" (Karmiloff-Smith, 1986). The field independent person, then, might be one who has developed modules for many information processing requirements, which are to some extent autonomous. In contrast, the field dependent person may not have "modularised" as many functions, or else may retain the output of these modules under the control of central processing. According to Fodor's (1983) ideas of information encapsulation, modular processes are affected only by local (ie. within module) context and not by global context, which is only achieved in central processing. If the field independent person has not only modularised much of information processing, but also runs these modules relatively autonomously, then their performance on many tasks might appear context-independent. The field dependent person, by contrast will use central processing to solve the same tasks. Thus they would be susceptible to effects of global context or central coherence. Another prediction might be that the field dependent person would show strong performance decrements under dual task conditions, relative to the field independent person who achieves more processing via modules.

Autistic people, who show surprisingly good EFT performance (Shah & Frith, 1983), may be thought of as abnormally field independent. In terms of the discussion above, then, autistic people would rely more on modular systems for information processing than is normal, relying less on central processing. This would liken the idea of weak central coherence to a notion of "over-modularisation" (although the same phenomena may be explained by lack of central control, even

with poor modularisation). Norris (1990) has suggested, in his description of the development of a connectionist model of an idiot savant calendrical calculator, that such abilities can only be modelled by taking a "highly structured and modular approach to learning". A characterisation of lack of central coherence in terms of "over-modularisation" would help to explain certain savant phenomena, and also help to define what is global (or central) versus local coherence. The distinction might be between coherence of information within modules and coherence of information between modules (ie. coordination of the outputs of different modules, in central processing). This intra- versus inter-module distinction may be helpful in making predictions about the limits of autistic coherence.

It would also be interesting to explore the possible relations between tests of central coherence, tests from the field dependence literature, and tests of executive functions. If central coherence plays a role in coordinating the outputs of different modules, it may be necessary for planned action, where procedures are not simply run off automatically (modular processing?) but are put together to form a plan in service of a goal (central processing). Perhaps a unifying concept in all these different formulations - central coherence, field dependence, modular processing, executive functions - is the idea of top-down versus bottom-up processing. In all these different conceptualisations, the autistic person can be thought of as more bottom-up than is normal, with the normal population showing between-individual (and within-individual, between-task) variation in the relative contributions of top-down and bottom-up processing. An intriguing question becomes, then, the nature of the relation between top-down processing and mental state representations; "knowing that" may require some ability to represent representations, which "knowing how" does not.

The concept of field dependence/independence may be useful, then, for the exploration of central coherence in autism - providing a well established set of tests, performance on which is correlated in normal subjects (Vernon, 1972). The concept of cognitive style also has value in suggesting that autistic people may be on the extreme end of a normal continuum of central coherence. If this is the case, tests such as those for field independence may be extremely useful for exploration of the extended phenotype in autism. Tasks are needed which will be sensitive to

individual differences in the cognitive abilities of the normal relatives of autistic people - and central coherence would appear to be a promising candidate for explaining the subtle differences observed in the cognitive and social functioning of the siblings and parents of autistic individuals (Bolton & Rutter, 1990). There is even some evidence that field dependence/independence is genetically determined: Goodenough, Grandini, Olkin, Pizzamiglio, Thayer and Witkin (1977) looked at families with at least three sons and an X chromosome marked for XGa factor. They found that the two brothers with the same X chromosome showed a significantly greater similarity on tests of field independence, but not on tests of visualisation, spatial rotation or verbal comprehension. In addition, there is an intriguing sex difference in field dependence, with females generally being more field dependent and males more field independent, although the source of this difference is far from clear (Bertini, Pizzamiglio & Wapner, 1986).

It is important to remember, however, that the autistic person may succeed at the EFT because he lacks central coherence, whereas the normal subject who does well on the EFT may do so by overcoming the pull of central coherence. In the same way, autistic people may be forced to adopt a field independent cognitive style due to a deficit in central processes (forcing them to use modular processes), whereas in normal subjects cognitive style may be due to more subtle factors, such as the relative efficiency of the two types of processing for the individual.

Concluding comment

The central coherence hypothesis draws into focus many features of autism which have recently been neglected in the investigation of the autistic social handicap. So, for example, while Wing's triad of impairments in socialisation, imagination and communication has been much discussed in the recent literature, far less attention has been given to Wing's (1981b) analysis of the "central core of the problem" in autism, which outlined three rather different points. While Wing (1981b) mentions as core problems both impairment in communication, and failure to recognise "human beings as different from other features of the environment" (handicaps which would follow from a lack of theory of mind), she gives as the third area

of handicap the failure to "seek out experiences and make a coherent story out of them". This feature of autism would appear to be well accounted for in terms of a deficit in central coherence. Similarly, the central coherence hypothesis draws into the foreground two of the elements of Asperger's (1944) original description, which - it was claimed in chapter 2 (p.50) - have been lost from more recent discussions of Asperger's syndrome. These two features are "disturbance of active attention" and "distance from the object" (giving a special "clarity of vision"). These can be seen as following from a deficit in central coherence. The effect of a peculiar calculation of relevance on the direction of attention has already been discussed. "Clarity of vision" may be a description of the autistic person's ability to resist context, and thus perceive parts more accurately, as demonstrated on the EFT and Block Design test.

The hypothesis that autistic people have a pervasive, unique and universal deficit in central coherence, then, takes the discussion of autism in this thesis full circle. From an initial focus on the necessary and sufficient features of autism and their explanation at the cognitive level, the discussion turned to theory of mind and the hypothesis that the inability to represent mental states accounts well for the core handicaps of autism. Through an investigation of two of these handicaps (in social and communicative understanding), and using Relevance theory to make very specific predictions about connection between these domains, the deficits of the most able autistic individuals were explored. Finally, Frith's notion of central coherence was discussed and extended, in an attempt to account for those elements of autism (and particularly of Asperger's syndrome) which are not well explained by a failure to attribute mental states. A bold but preliminary test of the strong hypothesis that autistic subjects as a group suffer from an impairment in deriving context-specific meaning, yielded positive results. The aim of this final chapter has, therefore, been to lay out a path for future exploration of this hypothesis. Such an exploration will require that we look again at the necessary and sufficient features of autism and at the co-occurring and core handicaps of related disorders.

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Appendix I

Theory of Mind Task Protocols

First-Order False Belief Tasks

1) *True belief task (Leslie and Frith, 1988)*

The experimenter (E1) places three boxes on the table and shows the subject, and the other experimenter (E2) that they are all empty. Then E1 gives E2 a coin to hide in any one of the boxes. E2 hides the coin, making sure the subject sees where it goes, and then leaves the room on some pretext, asking the subject; "Help me remember where I put my coin! Remember, its in the X box!" When E2 has left the room E1 says; "Now (E2's name) has gone right away. Can she see what we are doing? (See Question) While she's out I'm going to put another coin in one of the other boxes. Where shall I put it?" The subject or E1 then puts a second coin in one of the empty boxes, and the box is closed. E1 asks the subject the Memory Question; "Where did (E2's name) put the coin?" and checks that the subject knows the second coin's location; (Reality Question) "And where did we put the coin just now?" (2 control questions are counterbalanced for order). E1 then asks, "When (E2's name) comes back, where will she think her coin is?"(Belief Question).

One point is given for the correct answer: in the X box where she put it. Subjects must pass all control questions, the See, Memory and Reality Questions, to be included in the results.

2) *The Smarties Task (Perner et al, 1989)*

E1 shows the subject a sealed smarties tube, and asks; "What do you think is inside here?" The subject answers "smarties" or "sweets". E1 then opens the tube and shows the subject that it in fact contains a pencil. The subject is asked to name the pencil ("pen", "pencil", "crayon"), to check that he/she has the vocabulary to do

so. The pencil is put back in the tube, and the lid replaced. E1 then asks the subject; "In a minute, your friend Jack is going to come in. He hasn't seen this tube yet. When he comes in I'm going to show him this tube, closed up just like this. I'm going to ask him "What's in here?". What will he say? (Test Question)" The Reality Question is then asked, "What is really inside the tube?"

One point is given for the correct answer;"Smarties". Subjects must pass the control Reality Question to be included.

3) *The Sally-Ann Task (Baron-Cohen et al, 1985, adapted from Wimmer & Perner, 1983)*

The subject is introduced to two figures; "This is Mary and this is John. Mary has a basket and John has a box. Mary has a coin. She is going to put her coin in her basket to keep it safe when she goes out". The subject sees the toy figure put the coin in her basket and go out (under the table). E1 continues, "But while Mary is out, naughty John takes Mary's coin out of her basket and he puts it in his box!". The figure of John does this and then goes away. The subject is then asked 2 control questions about the original and current location of the coin: (Reality Question) "Where is the marble really?", (Memory Question) "Where did Mary put the Marble in the beginning?". The E1 then asks; "When Mary comes back, where will she think her coin is?"

One point is given for the correct answer, indicating the basket. Subjects who did not pass the control questions were excluded from the subject pool.

4) *The Three boxes Task (Leslie and Frith, 1988)*

As in the True Belief task, there are two experimenters and three boxes. As before E2 goes out after hiding a coin. But while E2 is out, E1 in this task moves that same coin to one of the other boxes. Control questions("Where did E2 put the coin?", "Where did we put the coin just now?") and Belief Question are as above.

The subject gets one point for answering that E2 will expect her coin to be in the

box she put it in, or an answer to that effect (eg. pointing to the original box in response to Belief Question).

Total maximum score for First-order False Belief = 4.

First-order Deception Tasks

5) Sally-Ann and Baddie Task (after Wimmer & Perner, 1983)

As in Sally-Ann task, Mary hides the coin and leaves, then John moves the coin to his box. When Mary returns the subject is asked the Belief Question; "Where does Mary think her coin is?" If incorrect the subject is prompted: "Did she see John move the coin?". The subject is told the correct answer if prompts fail. Then Burglar Bill is introduced, and the subject is told that he wants to steal Mary's coin, and that he will ask her where it is. The subject is told that Mary does not want him to get the coin, and wants to keep it for herself. The burglar figure then asks Mary; "Where's your coin, in the box or the basket?" (order counterbalanced). The Subject is reminded that Mary does not want him to find the coin, and is then asked the Deception Question; "Where will Mary tell Burglar Bill to look for the coin?" Reality and Memory Questions are also asked; "Where is the coin really?" and "Where did Mary put the coin in the beginning?"

One point is scored if the subject indicates that Mary will tell the burglar to look in the box - ie. where the coin really is, which is where Mary thinks it is not. As before, subjects who failed control questions were excluded.

6) *Three Boxes Deception Task*

As in three boxes false belief task, E2 hides coin and leaves room, then E1 moves coin. As before, child is asked where E2 will think the coin is, and prompted or told the correct location as in 5). E2 then re-enters and is met by Greedy Pig (a handpuppet), who asks E2; "Where's your coin? I want it so I can buy sweets!" The subject is told that E2 does not want the pig to find her coin, and E1 then asks; "Where will E2 tell Greedy pig to look for the coin?" (Deception Question). Memory and Reality Questions are asked as above.

One point is scored for a correct answer. Only subjects passing memory check questions were included in the subject pool.

Total maximum score for First-order Deception = 2.

Second-order False Belief Tasks

7) *The Ice cream van Task* (Perner & Wimmer, 1985; Baron-Cohen, 1989)

The subject is shown the toy village scene, and the park, church and John and Mary's houses are pointed out. The subject is introduced again to the John and Mary figures used earlier, and shown that this time they are in the park. The following story is told as the figures act out the events:

Today Mary and John are in the park. Along comes the ice cream van. John wants to buy an ice cream, but he has not got any money with him. He'll have to go home first and get his money before he can buy an ice cream. The ice cream man tells John, "It's alright John, I'll be here in the park all day. So you can go and get your money and come back and buy your ice cream. I'll still be here." So John runs off home to get his money.

But, when John has gone, the ice cream man changes his mind. He decides he won't stay in the park all afternoon, instead he'll go and sell ice cream outside the church. He tells Mary, "I won't stay in the park, like I said I would. I'm going to the church instead". (Comprehension Check 1) Did John hear the ice

cream man tell Mary that? (Subject is prompted if they answer incorrectly; eg. subject is asked, "Is she there? Can she hear?").

So in the afternoon, Mary goes home and the ice cream man sets off for the church. But on his way he meets John. So he tells John, "I changed my mind, I won't be in the park, I'm going to sell ice cream outside the church this afternoon". The ice cream man then drives to the church. (Comprehension Check 2) Did Mary hear the ice cream man tell John that? (Subjects are prompted if incorrect).

In the afternoon, Mary goes over to John's house and knocks on the door. John's mother answers the door. Mary asks, "Is John in?". John's mother says, "Oh, I'm sorry Mary, John's gone out. He's gone to buy an ice cream". (Belief Question) "Where does Mary think John has gone to buy an ice cream?"

Subject scores 2 points if spontaneously correct (indicating the park), and 1 point if correct only after a prompt; "Did Mary hear the ice cream man tell John he'd be at the church?"

The subject is then asked the Justification Question; "Why does Mary think that?" Subject scores 2 points for a full second-order answer; eg. "She thought John didn't know" or "She didn't know that John knew". Subject scores 1 point for a first-order or implicitly correct justification; eg. "She didn't know" or "She wasn't there when the ice cream man told John".

Control Memory and Reality Questions are then asked ("Where was the ice cream man in the beginning?" and "Where is the ice cream man now?"). As above, control questions must be passed for a subject to be included.

8) *The Simon Story Task*

This is exactly like the ice cream van task except that here Mary and John are in the playground and meet Simon. The subject is told that Simon is very clever and Mary wants him to help her with her maths homework. But she has not got her

books with her. The story continues as in the ice cream van version. Mary leaves and Simon decides not to stay in the playground as he had told Mary, but to go to the zoo. He tells John this. Simon bumps into Mary on the way to the zoo and tells her. John goes over to Mary's house and is told that Mary has gone to meet Simon. Questions and Checks are as before.

Total maximum Second-order False Belief score; Performance=4, Justification=4.

Second-order Deception Tasks

9) *The Burglar Bill Story Task*

Using the same village scene, the following story is narrated and acted out:

"This is Burglar Bill. He has just robbed a shop and he's making his get-away. He's running away from the police. He's running away as fast as he can when he meets his brother. This is Burglar Bill's brother, Bob. He says to Bob, "Don't let the police find me, don't let them find me!". Then he runs and hides in the church. Remember, he's hiding in the church.

Just then the police arrive. They have looked everywhere for Burglar Bill; everywhere except the church and the park. They are going to ask Bob, "Where's Burglar Bill? IS he in the church or in the park [order counterbalanced]?" But the police recognise Bob and they know he will try to save his brother, Burglar Bill. They expect him to lie, and wherever he tells them, they will look in the other place. But Bob is very very clever, and he wants to save his brother. He knows they do not trust him."

Deception Question: "Where will Bob tell the police to look for Burglar Bill? In the church or in the park [order of locations counterbalanced]?"

Subjects score 2 points for a spontaneous correct answer, indicating the church. They scored 1 point if correct only after a prompt ("But do the police believe

Bob?").

Justification Question: "Why will Bob tell them that?"

Subjects score 2 for a full second-order answer; eg. "Because he knows they expect him to lie". One point was given for first-order/implicit answers; eg. "They don't trust him" or "They'll look the other place".

Comprehension Check: "Where will the police look if he says that?"

Subjects only scored points on the Deception Question if the Comprehension Check question was correctly answered (ie. by indicating the location Bob did not say).

Reality Question: "Where is Bob hiding really?". Subjects who answered this question incorrectly were excluded from the results.

10) *John and Mary Double Bluff Story*

The following story is told and acted out:

This is John and this is Mary. Mary has stolen John's coin and she has hidden it in the zoo. But John doesn't know where the coin is. He has looked everywhere for his coin, except the zoo and the playground. Now he has caught Mary and he's going to ask her, "Where's my coin? Is it in the zoo or in the playground?" But John knows that Mary will not want to tell him. He expects her to lie. But Mary is very clever, and she knows John expects her to lie.

Deception Question: "Where will Mary tell John to look for his coin - in the zoo or in the playground [order of locations counterbalanced]?"

As before, subjects score 2 if spontaneously correct, 1 if correct after prompt.

Justification Question: "Why will Mary tell him to look there?"

As above, 2 points are given for a second-order justification, and 1 for a first-order or implicitly correct answer.

Comprehension Check: "Where will John look for his coin if she tells him its there (location mentioned by subject)?"

A correct answer to this question is a condition for scoring any points. A Reality Question was also asked as above, and a correct answer to this question was an inclusion criterion.

Total maximum Second-order Deception score; Performance=4, Justification=4.

Individual Subject Characteristics and Theory of Mind Battery Results

Young Normal Subjects;

ID	AGE (yrs)	Theory of mind Battery results					
		FB1 (m=4)	DEC1 (m=2)	FB2		DEC2	
				Perf. (m=4)	Just. (m=4)	Perf. (m=4)	Just. (m=4)
101	8.0	4	2	4	2	4	1
102	7.8	4	2	3	0	4	2
103	7.6	4	2	0	0	4	0
104	7.3	4	2	4	2	4	0
105	7.0	4	2	0	0	4	0
106	6.5	4	2	3	2	4	0
107	7.8	4	2	4	2	4	0
108	6.8	4	2	2	0	4	2
109	7.8	4	2	4	3	4	2
110	7.3	4	2	4	0	4	0
111	7.0	4	2	0	0	4	0
112	6.5	4	2	4	0	4	0
113	6.6	4	2	4	4	4	2
114	8.8	4	2	3	2	4	2
115	8.8	4	2	4	4	4	2
116	8.7	4	2	4	2	3	0
117	8.5	4	2	1	1	2	2
118	9.3	4	2	4	4	4	2
119	8.9	4	2	3	1	4	2
120	9.6	4	2	4	0	4	1
121	8.7	4	2	4	4	4	4
122	8.0	4	2	4	0	4	0
123	8.7	4	2	4	4	4	2
124	8.7	4	2	4	2	4	0
125	9.1	4	2	4	0	4	0
126	9.2	4	2	4	2	4	2
127	9.0	4	2	4	0	4	0
128	9.4	4	2	4	2	4	3
129	9.0	4	2	4	4	4	2
130	9.0	4	2	4	1	4	2
131	9.5	4	2	4	3	4	0
132*	9.4						
133*	9.7						
134*	8.0						

* These subjects were not tested on the theory of mind tasks, but did complete the "Strange stories".

MLD Children;

ID	AGE (yrs)	VMA (yrs)	VIQ	FB1	Theory of mind Battery				
					DEC1	FB2		DEC2	
						Perf.	Just.	Perf.	Just.
150	12.9	09.5	079	4	2	4	2	4	2
151	13.5	08.0	066	4	2	4	2	4	3
152	12.7	08.0	068	4	2	4	2	4	0
153	12.9	04.4	040	4	1	4	2	2	0
154	12.0	10.0	089	4	1	3	2	2	0
155	12.4	08.6	075	4	2	4	2	2	1
156	12.1	06.8	063	4	2	4	2	4	2

MLD Adults;

ID	AGE (yrs)	VMA (yrs)	VIQ	FB1	Theory of mind Battery				
					DEC1	FB2		DEC2	
						Perf.	Just.	Perf.	Just.
157	35.2	08.1	040	4	2	4	2	4	2
158	22.0	07.0	040	4	2	4	2	4	2
159	21.0	06.7	040	4	2	4	2	4	2
160	19.2	11.9	059	4	2	4	0	3	2
161	27.1	06.0	040	2	2	4	1	3	1
162	38.0	04.5	040	4	1	4	0	4	2
163	27.0	03.9	040	3	1	4	0	3	0

Autistic Subjects;

ID	AGE (yrs)	VIQ	PIQ	FIQ	FB1	Theory of mind Battery			
						DEC1	FB2	DEC2	
							Perf. Just.	Perf. Just.	
No ToM Autistics									
170	16.0	062	087	072	2	0	0	0	0
171	18.9	052	055	051	1	0	0	0	0
172	10.9	052	046	045	1	0	0	0	0
173	18.0	076	099	085	2	0	0	0	0
175	13.5	057	072	062	1	0	0	0	0
190	28.2	075	112	090	3	0	0	0	0
1st-order ToM Autistics									
176	08.9	100	106	102	4	1	0	0	1
177	12.0	065	095	078	4	2	0	0	0
178	17.9	076	087	080	4	2	2	0	1
179	13.9	064	064	060	4	1	2	0	1
186	17.6	084	092	086	4	1	2	0	0
189	19.2	066	074	069	4	1	0	0	0
196	24.6	100	081	091	4	1	0	0	2
2nd-order ToM Autistics									
180	16.0	---	---	---	4	2	3	2	4
183	17.5	093	079	080	4	2	4	3	4
184	18.9	090	109	098	4	2	4	0	4
185	11.5	101	123	112	4	2	4	1	4
187	16.1	058	084	069	4	1	4	1	4
188	15.3	101	085	092	4	2	4	2	4
197	25.5	094	086	090	4	2	4	2	4
Autistics not allotted to ToM Groups									
174	13.5	---	---	---	4	0	4	1	0
181	17.7	---	---	---	4	2	4	0	1
182	15.5	---	---	---	4	2	4	0	2
191	24.5	069	103	083	4	1	2	0	0
192	36.2	092	095	093	4	2	3	0	0
193	45.1	087	072	080	4	2	2	0	0
194	31.3	100	105	102	3	1	2	0	1
195	25.8	089	099	093	4	1	4	0	0

Appendix II

"Strange Stories" Battery Materials

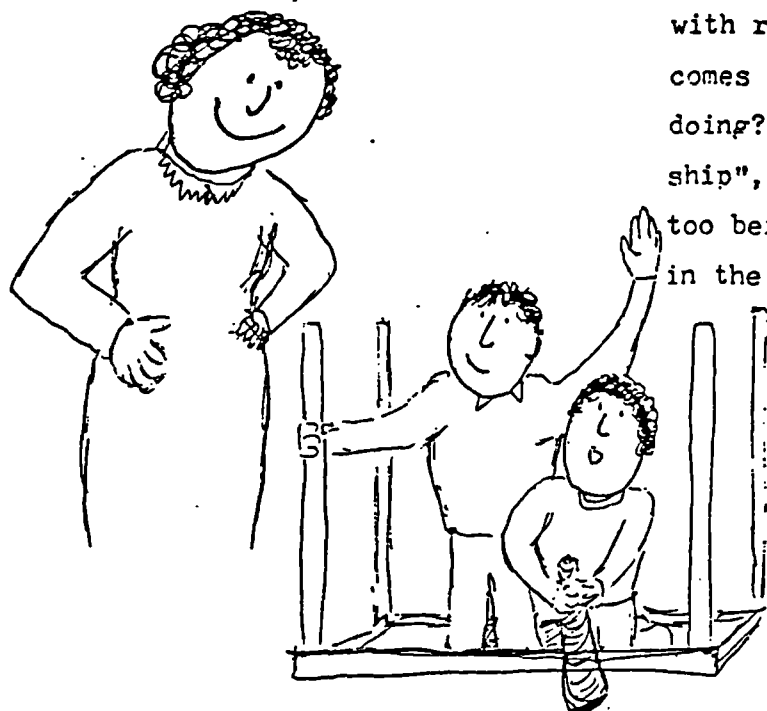
Instructions to young normal subjects;

"On the following pages you will find some very short stories, each one followed by some questions. I would like you to read the stories carefully, and then answer the questions. There are no right or wrong answers, so don't worry about how you answer, just write what you think about the story. Some of the questions ask; "Is it true...?" After these questions there are three possible answers for you to choose from; YES / NO / DON'T KNOW. Please draw a ring round the answer you think is right. Please only circle DON'T KNOW if you really cannot decide, try otherwise to answer YES or NO.

This is not a test, and no marks will be given. It is just to see what you think about my stories. What is important is what you think, not what anyone else says. So please don't ask anyone else to help you with the questions, and don't compare answers with other people. If you need help reading some of the stories, or you need to ask about a difficult word, then you can ask someone. But please decide on the answers to the questions on your own. This is **your own** story book, and I want **your** help with it, not your friend's or your parents'!"

The "Strange Stories"

Story Type: Pretend



Mark and Adam are having great fun! They have turned the kitchen table upside down and they are sitting in it, paddling along with rolled-up newspapers. When their mother comes in she laughs. "Whatever are you two doing?", she asks. "This table is a pirate ship", says Adam, "And you had better get in too before you sink - because you are standing in the sea!"

Is it true what Adam says?

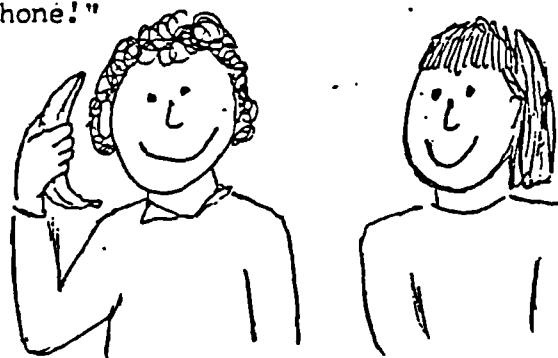
YES / NO / DON'T KNOW

Why does he say this?

Katie and Emma are playing in the house. Emma picks up a banana from the fruit bowl and holds it up to her ear. She says to Katie, "Look! This banana is a telephone!" Is it true, what Emma says?

YES / NO / DON'T KNOW.

Why does Emma say this?



Strange Stories: Joke



Today James is going to Claire's house for the first time. He is going over for tea, and he is looking forward to seeing Claire's dog, which talks about all the time. James likes dogs very much. When James arrives at Claire's house Claire runs to open the door, and her dog jumps up to greet James. Claire's dog is huge, it's almost as big as James! When James sees Claire's huge dog he says, "Claire, you haven't got a dog at all. You've got an elephant!"

Is it true, what James says?

YES / NO / DON'T KNOW.

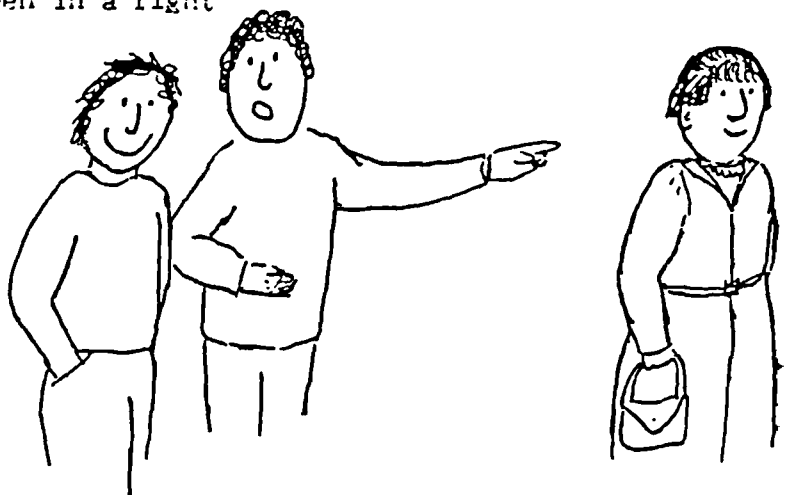
Why does James say this?

Daniel and Ian see Mrs. Thompson coming out of the hairdresser's one day. She looks a bit funny because the hairdresser has cut her hair much too short. Daniel says to Ian, "She must have been in a fight with a lawn-mower!"

Is it true, what Daniel says?

YES / NO / DON'T KNOW.

Why does Daniel say this?



Strange Stories: Lie

One day, while she was playing in the house, Anna accidentally knocks over and breaks her mother's favourite crystal vase. Oh dear, when mother finds out she will be very cross! So when Anna's mother comes home and sees the broken vase and asks Anna what happened, Anna says, "The dog knocked it over, it wasn't my fault!" Was it true, what Anna told her mother?

YES / NO / DON'T KNOW

Why did she say this?



John hates going to the dentist, because every time he goes to the dentist he needs a filling, and that hurts a lot. But John knows that when he has tooth-ache, his mother always takes him to the dentist. Now John has had tooth-ache at the moment, but when his mother notices he is looking ill and asks him, "Do you have tooth-ache, John?", John says, "No, mummy".

Is it true, what John says to his mother?

YES / NO / DON'T KNOW.

Why does John say this?



Strange Stories: White Lie



Is it true, what Helen said?

YES / NO / DON'T KNOW. just what I wanted."

Why did she say that to her parents?

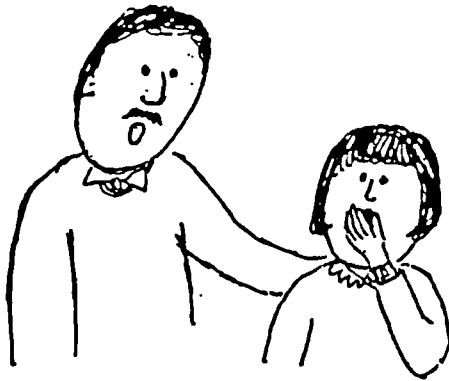
One day Aunt Jane came to visit Peter. Now Peter loves his aunt very much, but today she is wearing a new hat; a new hat which Peter thinks is very ugly indeed. Peter thinks his aunt looks silly in it, and much nicer in her old hat. But when Aunt Jane asks Peter, "How do you like my new hat?", Peter says, "Oh, its very nice." Was it true what Peter said?

YES / NO / DON'T KNOW.

Why did he say it?



Strange Stories: Figure of Speech



Emma has a cough. All through lunch she cough and coughs and coughs. Father says, "Poor Emma you must have a frog in your throat!"

Is it true, what father says to Emma?

YES / NO / DON'T KNOW.

Why does he say that?

William is a very untidy boy. One day his mother comes into his bedroom, and it is even more messy than usual! There are clothes, toys, and comics, everywhere. William's mother says to William, "This room is a pig sty!"

Is it true that William keeps pigs in his room?

YES / NO / DON'T KNOW.

Why does William's mother say this?



Strange Stories: Misunderstanding



Late one night old Mrs. Peabody is walking home. She doesn't like walking home alone in the dark because she is always afraid that someone will attack her and rob her. She is really a very nervous person! Suddenly, out of the shadows comes a man. He wants to ask Mrs. Peabody what time it is, so he walks towards her. When Mrs. Peabody sees the man coming towards her, she starts to tremble and says, "Take my purse, just don't hurt me please!"

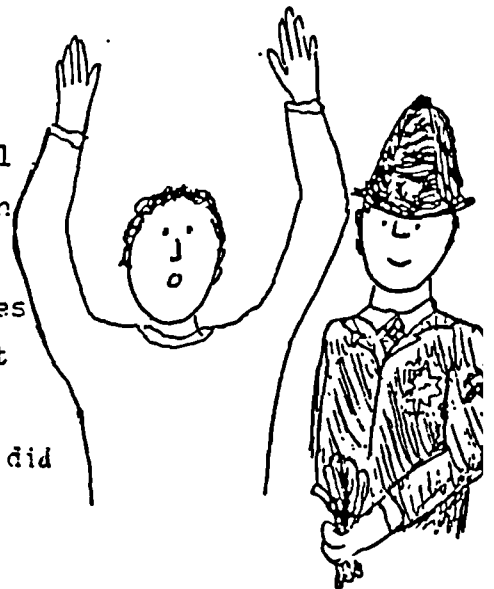
Was the man surprised at what Mrs. Peabody said?

YES / NO / DON'T KNOW.

Why did she say that, when he only wanted to ask her the time?

A burglar who has just robbed a shop is making his getaway. As he is running home, a policeman on his beat sees him drop his glove. He doesn't know the man is a burglar, he just wants to tell him he dropped his glove. But when the policeman shouts out to the burglar, "Hey, you! Stop!", the burglar turns round, sees the policeman and gives himself up. He puts his hands up and admits that he did the break-in at the local shop.

Was the policeman surprised by what the burglar did?



YES / NO / DON'T KNOW

Why did the burglar do this, when the policeman just wanted to give him back his glove?

Strange Stories: Double Bluff



During the war, the Red army capture a member of the Blue army. They want him to tell them where his army's tanks are; they know they are either by the sea or in the mountains. They know that the prisoner will not want to tell them, he will want to save his army, and so he will certainly lie to them. The prisoner is very brave and very clever, he will not let them find his tanks. The tanks are really in the mountains. Now when the other side ask him where his tanks are, he says, "They are in the mountains".

Is it true what the prisoner said?

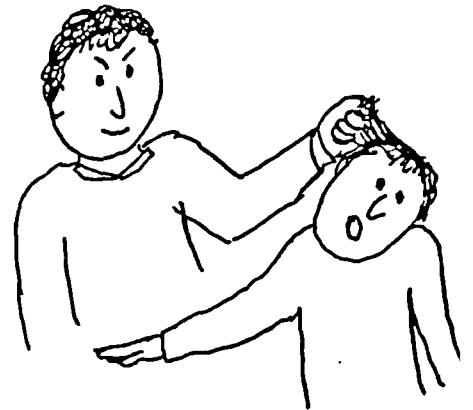
YES / NO / DON'T KNOW.

Where will the other army look for his tanks?

BY THE SEA / IN THE MOUNTAINS.

Why did the prisoner say what he said?

Simon is a big liar. Simon's brother Jim knows this, he knows that Simon never tells the truth! Now yesterday Simon stole Jim's ping-pong bat, and Jim knows Simon has hidden it somewhere though he can't find it. He's very cross. So he finds Simon and he says, "Where is my ping-pong bat? You must have hidden it either in the cupboard or under your bed, because I've looked everywhere else. Where is it, in the cupboard or under your bed?" Simon tells him the bat is under his bed.



Was it true, what Simon told Jim?

YES / NO / DON'T KNOW.

Where will Jim look for his ping-pong bat?

IN CUPBOARD / UNDER BED.

Why will Jim look there for his bat?

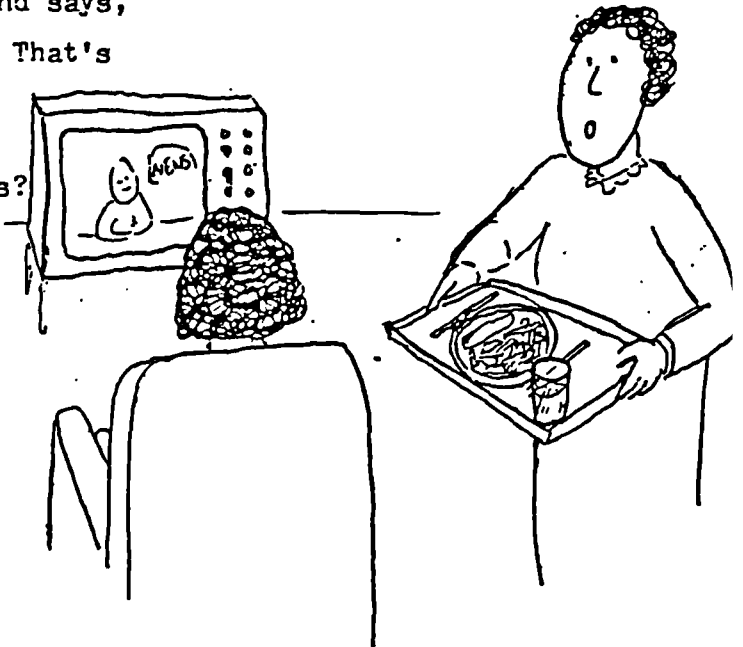
Strange Stories: Sarcasm

Ann's mother has spent a long time cooking Ann's favourite meal; fish and chips. But when she brings it in to Ann, she is watching T.V. and she doesn't even look up, or say thank you. Ann's mother is cross and says, "Well that's very nice, isn't it! That's what I call politeness!"

Is it true, what Ann's mother says?

YES / NO / DON'T KNOW.

Why does Ann's mother say this?



Sarah and Tom are going on a picnic. It is Tom's idea, he says it is going to be a lovely sunny day for a picnic. But just as they are unpacking the food, it starts to rain, and soon they are both soaked to the skin. Sarah is cross. She says, "Oh yes, a lovely day for a picnic alright!"

Is it true, what Sarah says?

YES / NO / DON'T KNOW.

Why does Sarah say this?

Strange Stories: Persuasion

Jill wanted to buy a kitten, so she went to see Mrs. Smith, who had lots of kittens she didn't want. Now Mrs. Smith loved the kittens, and she wouldn't do anything to harm them, though she couldn't keep them all herself. When Jane visited she wasn't sure she wanted one of Mrs. Smith's kittens since they were all males and she had wanted a female. But Mrs. Smith said, "If no one buys the kittens I'll just have to drown them!"

Was it true, what Mrs. Smith said?

YES / NO / DON'T KNOW.

Why did Mrs. Smith say this to Jane?



Brian is always hungry. Today at school it is his favourite meal - sausages and beans. He is a very greedy boy, and he would like to have more sausages than anyone else, even though his mother will have made him a lovely tea when he gets home! But everyone is allowed two sausages and no more. When it is Brian's turn to be served, he says, "Oh, please can I have four sausages, because I won't be having any tea when I get home!"

Is it true, what Brian says?

YES / NO / DON'T KNOW.

Why does he say that?



Strange Stories: Contrary Emotions

Jane and Sarah are best-friends. They both entered the same painting competition. Now Jane wanted to win this competition very much indeed, but when the results were announced it was her best-friend Sarah who won, not her. Jane was very sad she had not won, but she was happy for her friend, who got the prize. Jane said to Sarah, "Well done, I'm so happy you won!" Jane said to her mother "I am sad I did not win that competition!" Is it true what Jane said to Sarah?



YES / NO / DON'T KNOW.

Is it true what Jane said to her mother?

YES / NO / DON'T KNOW.

Why does Jane say she is happy and sad at the same time?

Today, Katy wants to go on the swings in the playground. But to get to the playground she knows she has to pass old Mr. Jones' house. Mr. Jones has a nasty fierce dog, and every time Katy walks past the house the dog jumps up at the gate and barks. It scares Katy awfully, and she hates walking past the house because of the nasty dog. But Katy does so want to play on the swings. Katy's mother asks her, "Do you want to go out to the playground?" Katy says, "No".



Is it true what Katy says?

YES / NO / DON'T KNOW.

Why does she say she doesn't want to go to the playground, when she so wants to go on the swings that are there?

Strange Stories: Appearance/Reality

On Christmas Eve Alice's mother takes her to the big Department Store in town. They go to look in the toy department. In the toy department Mr. Brown, Alice's next-door neighbour is dressed up as Santa Claus, giving out sweets to all the children. Alice thinks she recognises Mr. Brown, so she runs up to him and asks, "Who are you?" Mr. Brown answers, "I'm Santa Claus!"

Is it true what Mr. Brown says?

YES / NO / DON'T KNOW.

Why does he say this?



It is Halloween, and Chris is going to a fancy-dress party. He is going as a ghost. He wears a big white sheet with eyes cut out to see through. As he walks to the party in his ghost costume, he bumps into Mr. Brown. It is dark, and Mr. Brown says, "Oh! Who is it?" Chris answers, "I'm a ghost, Mr. Brown!"

Is it true, what Chris says?

YES / NO / DON'T KNOW.

Why does Chris say this?

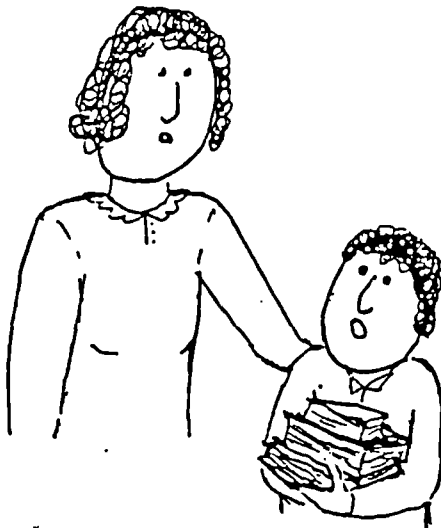
Strange Stories: Forgetting

Yvonne is playing in the garden with her doll. She leaves her doll in the garden when her mother calls her to come in for lunch. While they are having lunch, it starts to rain. Yvonne's mother asks Yvonne, "Did you leave your doll in the garden?" Yvonne answers, "No, I brought her in with me, mummy".

Is it true, what Yvonne says?

YES / NO / DON'T KNOW

Why does Yvonne say this ?



At school today John was not present. He was away ill. All the rest of Ben's class were at school though. When Ben got home after school his mother asked him, "Was every one in your class at school today?" Ben answers, "Yes mummy".

Is it true what Ben said?

YES / NO / DON'T KNOW.

Why did Ben say that?

Physical Stories

- 1) It was snowing and Bill went out into the garden to build a snowman. He made a fine snowman, with the snow in the garden. But after Bill had gone to bed that night, the weather got a lot warmer - and by the morning the snowman had melted away. There was nothing left but a puddle of water in the garden, where the snowman had stood.

Q: Is it true that Bill made a snowman?

Q: Why was the snowman not there the next morning?

- 2) Paul has a pet rabbit. He is always very careful to shut the door of the rabbit's cage after feeding him or playing with him. Today, as usual, he shuts the cage door after feeding his rabbit. But, oh dear! After Paul has gone the wind blows the door of the cage open, and the rabbit gets out.

Q: Is it true that Paul fed his rabbit today?

Q: Why did the cage door open?

- 3) Mother has just made a cake for Oliver's birthday. It is a lovely cake, with icing on it, saying "Happy Birthday Oliver". It has ten candles on it, because Oliver is ten years old this birthday. But as mother carries the cake through to the dinning room, to give it to Oliver, she trips and drops the cake. It falls on the floor and is ruined - no one can eat it now!

Q: Is it true that Oliver's cake had fifteen candles on it?

Q: Why is the cake now ruined?

- 4) Sally is in the garden. She is sowing seeds, so that next year she will have lots of vegetables in her garden. She sows seeds for carrots, lettuces, and peas. She sows the seeds well, but when she goes inside after sowing them, the birds fly down and eat up all Sally's seeds! Poor Sally, not one of her seeds is left!

Q: Is it true that Sally sowed seeds for turnips and sweeds?

Q: Why will Sally not have any vegetables in her garden?

Physical Stories

- 5) John parked his car on a steep hill in town while he went shopping. Unfortunately, the brakes on John's car are not very good. The handbrake is not strong enough to hold the car on the steep slope, and the car soon starts to roll down the hill. At the bottom of the hill John's car crashes into a lorry that is parked there. Luckily, there was no one in the lorry, so no one was hurt.

Q: Is it true that there was someone in the lorry?

Q: Why did the car roll down the hill

- 6) Kate was making supper. She made a casserole and put it in the oven. She turned the oven on high, so the casserole would be cooked by the time she got back from visiting her friend. But while Kate was out, there was a power-cut. All the electricity in Kate's house went off, and her cooker did not work. Oh dear! the casserole won't be cooked now!

Q: Is it true that Kate was making lunch?

Q: Why won't the casserole be cooked when Kate gets home?

Individual Subject Scores on Physical Stories

Young Normals:

Adults:

MLDs:

Autistics:

ID	Score										
101	6	121	6	135	6	150	6	170	6	186	6
102	6	123	6	136	6	151	6	171	5	188	6
107	6	124	5	137	6	152	6	172	6	189	6
109	6	125	6	138	6	153	5	173	6	190	6
110	6	126	5	139	6	154	6	176	6	191	6
111	6	127	6	140	6	155	6	177	5	192	6
113	6	128	6	141	6	156	6	178	6	193	6
114	6	129	6	142	6	157	6	180	6	195	6
115	5	130	6	143	6	158	6	181	6	196	6
116	6	131	6	144	6	159	6	182	6	197	6
117	6	132	6			160	6	183	6		
119	6	133	6			161	6	184	6		
		134	6			162	5	185	6		

Examples of Subjects' Answers to the "Why?" Question

(given to co-rater)

Answers rated as Physical State Justifications

"She's hungry"
"Because her hair is cut too short"
"It's shaped like a telephone"
"So she wouldn't get spanked"
"In order to sell the kittens"
"He's dressed as Santa Claus"
"She won the competition"
"That's where it is"

Answers rated as Mental State Justifications

"Because he doesn't like the dentist"
"She's cross"
"He's lying"
"To fool her"
"She doesn't want to be in trouble"
"She's just pretending its a phone"
"Its just an expression people use, its not literal"
"He's making a joke"
"She thought it was a telephone"
"He knows that they won't believe him"
"She doesn't know he just wants to know the time""
"She doesn't want to upset them"
"To make them happy"

Covalidation of Story ratings

Numbers [%] of concordant ratings, for justifications by story type

Story Type	No. Answers (Max=73)	Right/Wrong No. [%]	Mental/Physical No. [%]	Both No. [%]
Pretend	72	70 [98.6]	71 [98.6]	69 [95.8]
Joke	71	71 [100]	70 [98.6]	70 [98.6]
Lie	71	71 [100]	70 [98.6]	70 [98.6]
White Lie	71	66 [92.9]	70 [98.6]	65 [91.6]
Fig. Speech	73	73 [100]	73 [100]	73 [100]
Misunderstand	68	67 [98.5]	68 [100]	67 [98.5]
Double Bluff	71	69 [97.2]	70 [98.6]	68 [95.8]
Sarcasm	66	65 [98.5]	65 [98.5]	64 [96.9]
Persuasion	72	72 [100]	72 [100]	72 [100]
Con. Emotion	73	73 [100]	73 [100]	72 [98.6]
App/Reality	72	69 [95.8]	70 [97.2]	69 [95.8]
Forget	72	71 [98.6]	72 [100]	71 [98.6]

Individual Subjects' Results from "Strange Stories"

Group	Total Score (Max=24)	N. Correct justifications Mental	Physical	N. Incorrect justifications Mental	Physical
<i>Young Normals:</i>					
101	11	10	1	8	0
102	21	16	5	2	0
107	19	15	4	4	1
109	19	14	5	2	0
110	23	17	6	1	0
111	18	12	6	3	1
113	21	16	5	2	0
114	20	16	4	3	1
115	20	15	5	2	0
116	21	17	4	1	0
117	18	17	1	3	1
119	19	15	4	4	0
120	19	15	4	4	0
121	23	16	7	0	0
123	24	16	8	0	0
124	24	22	2	0	0
125	20	17	3	4	0
126	23	19	4	1	0
127	19	14	5	4	0
128	24	20	4	0	0
129	24	19	5	0	0
130	21	12	9	1	0
131	24	21	3	0	0
132	23	21	2	0	0
133	24	20	4	0	0
134	24	21	3	0	0
<i>Normal adults:</i>					
135	24	24	0	0	0
136	24	23	1	0	0
137	22	22	0	0	0
138	23	18	5	0	0
139	24	24	0	0	0
140	24	22	2	0	0
141	24	24	0	0	0
142	24	24	0	0	0
143	24	20	4	0	0
144	24	24	0	0	0

Group	Total Score (Max=24)	N. Correct justifications		N. Incorrect justifications	
		Mental	Physical	Mental	Physical
<i>MLD Subjects:</i>					
150	19	12	07	01	03
151	23	18	05	01	00
152	23	13	10	00	01
153	22	20	02	02	00
154	22	15	07	01	01
155	22	15	07	01	01
156	22	16	06	00	02
157	22	18	04	01	01
158	23	17	06	00	01
159	20	15	05	00	04
160	24	18	06	00	00
161	19	15	04	01	03
162	17	15	02	01	04
<i>Autistic Subjects in "No theory of mind" Group:</i>					
170	09	07	02	09	06
171	07	03	04	08	09
172	06	05	01	16	02
173	07	04	03	15	02
190	07	04	03	07	05
<i>"Able" Autistic Subjects, also in "first-order theory of mind" Group:</i>					
176	09	03	06	06	00
177	13	13	00	10	01
178	14	10	04	04	04
186	16	09	07	06	02
189	14	05	09	04	05
196	11	06	05	06	06
<i>"Able" Autistic Subjects, also in "second-order theory of mind" Group:</i>					
197	21	14	07	01	01
180	20	13	07	03	01
183	20	19	01	04	00
184	21	18	03	03	00
185	21	17	04	03	00
188	17	11	06	06	01
<i>"Able" Autistic Subjects not placed in theory of mind groups:</i>					
181	10	05	05	03	03
182	18	13	05	00	05
191	12	08	04	06	01
192	15	11	04	07	01
193	17	12	05	04	00
195	12	12	00	11	00

Appendix III

Materials from Relevance Battery

Experiment 1: Idioms task materials

- | | |
|-------------------------|---|
| 1) MISS THE BOAT | Not catch the boat
Let an opportunity pass you by |
| 2) BUTTON YOUR LIP | Keep silence
Close your lips |
| 3) CLEAR THE AIR | Sort out an old problem
Air the room |
| 4) BREAK THE ICE | Split the ice into little pieces
Get the party going |
| 5) CHEW THE FAT | Eat the fat
Have a chat |
| 6) BURY THE HATCHET | Make up and forgive old grievances
Hide the hatchet |
| 7) TAKE UNDER YOUR WING | Put your arm around
Look after and protect |
| 8) THROW IN THE SPONGE | Submit and give in
Finish with the sponge and throw it away |
| 9) TURN THE TABLES | Put the tables upside down
Reverse the situation |
| 10) PUT YOUR FOOT DOWN | Insist on things being done your way
Place your foot on the ground |

Experiment 2: Simile versus Metaphor task materials

Subjects received 3 sets of sentences (A, B and C), one in each condition (Synonym, Simile, Metaphor). No subject received the same set of sentences more than once, and each set appeared equally often in each of the three conditions.

Synonym Condition

Sentence set A

- 1) The oak tree was so knarled and crooked. It really was...
- 2) Jane was so pale and quiet. She really was...
- 3) Sarah was so beautiful. She really was...
- 4) Steve was always rushing around, leaving everything in a mess. He really was...
- 5) Everyone found it hard to make friends with Penny. She really was...

Choose one item from the following list to complete each sentence;

lovely unwell energetic ancient generous unapproachable

Sentence set B

- 1) The dog was so wet. It really was...
- 2) Carol glared at Nicola. She was so cross her eyes really were...
- 3) The night sky was so clear. The stars really were...
- 4) Simon just couldn't make Lucy understand. She really was...
- 5) Caroline was so embarrassed. Her face really was...

Choose one item from the following list to complete each sentence;

bright late full of hatred soaking red obstinate

Sentence set C

- 1) The dancer was so graceful. She really was...
- 2) Father was very very cross. He really was...
- 3) Michael was so cold. His nose really was...
- 4) Ian was very clever and tricky. He really was...
- 5) Ann always felt safe with Tom. He really was...

Choose one item from the following list to complete each sentence;

cunning furious comforting hungry chilly agile

Simile Condition

Sentence set A

- 1) The oak tree was so knarled and crooked. It was like...
- 2) Jane was so pale and quiet. She was like...
- 3) Sarah was so beautiful. She was like...
- 4) Steve was always rushing around, leaving everything in a mess. He was like...
- 5) Everyone found it hard to make friends with Penny. She was like...

Choose one item from the following list to complete each sentence;

a rose a ghost an old woman a fortress a hurricane a sieve

Sentence set B

- 1) The dog was so wet. It was like...
- 2) Carol glared at Nicola. She was so cross her eyes were like...
- 3) The night sky was so clear. The stars were like...
- 4) Simon just couldn't make Lucy understand. She was like...
- 5) Caroline was so embarrassed. Her face was like...

Choose one item from the following list to complete each sentence;

a brick wall dresses daggers a beetroot a walking puddle diamonds

Sentence set C

- 1) The dancer was so graceful. She was like...
- 2) Father was very very cross. He was like...
- 3) Michael was so cold. His nose was like...
- 4) Ian was very clever and tricky. He was like...
- 5) Ann always felt safe with Tom. He was like...

Choose one item from the following list to complete each sentence;

an icicle a fox a safe harbour a hat a swan a volcano

Metaphor condition

Sentence set A

- 1) The oak tree was so knarled and crooked. It really was...
- 2) Jane was so pale and quiet. She really was...
- 3) Sarah was so beautiful. She really was...
- 4) Steve was always rushing around, leaving everything in a mess. He really was...
- 5) Everyone found it hard to make friends with Penny. She really was...

Choose one item from the following list to complete each sentence;

a rose a ghost an old woman a fortress a hurricane a sieve

Sentence set B

- 1) The dog was so wet. It really was...
- 2) Carol glared at Nicola. She was so cross her eyes really were...
- 3) The night sky was so clear. The stars really were...
- 4) Simon just couldn't make Lucy understand. She really was...
- 5) Caroline was so embarrassed. Her face really was...

Choose one item from the following list to complete each sentence;

a brick wall dresses daggers a beetroot a walking puddle diamonds

Sentence set C

- 1) The dancer was so graceful. She really was...
- 2) Father was very very cross. He really was...
- 3) Michael was so cold. His nose really was...
- 4) Ian was very clever and tricky. He really was...
- 5) Ann always felt safe with Tom. He really was...

Choose one item from the following list to complete each sentence;

an icicle a fox a safe harbour a hat a swan a volcano

Experiment 3: Metaphor versus Irony task materials

The following five stories were presented in random order:

Cake Story

David is helping his mother make a cake. She leaves him to add the eggs to the flour and sugar. But silly David doesn't break the eggs first - he just puts them in the bowl, shells and all! What a silly thing to do! When mother comes back and sees what David has done, she says;

"Your head is made out of wood!"*

Q: What does David's mother mean? Does she mean David is clever[#] or silly[#]? (silly)

Just then father comes in. He sees what David has done and he says;

"Whataclever boy you are, David!"*

Q: What does David's father mean? Does he mean David is clever[#] or silly[#]? (silly)

* The order of presentation of the metaphorical and ironic utterances was varied systematically in all stories.

[#] The order of the alternatives presented was varied systematically in all stories.

Dog Story

Toby is always boasting about how brave he is. But one day, when Toby is shopping with his friends Meg and Steve, a big dog runs up to him and starts barking. Toby is very scared, and hides behind Meg and Steve. Meg laughs, and she says;

"Look at Toby, he's just a jellyfish!"

Q: What does Meg mean? Does she mean Toby is a coward or brave? (coward)

Steve says to Toby;

"Gosh, you are so brave Toby!"

Q: What does Steve mean? Does he mean Toby is a coward or brave? (coward)

Cinema Story

Robert could never make up his mind about anything. So when Ian and Carol asked him if he would like to go to the cinema that evening, Robert couldn't decide. He took so long trying to make up his mind, that by the time he'd decided to go, they had missed the first half of the film! Ian said;

"Robert, you really are wonderfully decisive!"

Q: What does Ian mean? Does he mean Robert is good or isn't good at making up his mind? (isn't good)

Carol says to Robert;

"You are just a ship without a captain!"

Q: What does Carol mean? Does she mean Robert is good or isn't good at making up his mind? (isn't good)

Dress Story

Jane and Ann are friends. But one day Jane takes Ann's favourite dress without asking her. She wears it to a party. Ann goes to the party too, and she sees Jane wearing the dress she wanted to wear that evening. She is very upset, and she says to Jane;

"A fine friend you are, Jane!"

Q: What does Ann mean? Does she mean that Jane is a good friend or a bad friend? (a bad friend)

When Ann's mother hears what Jane has done, she says;

"That Jane is a snake!"

Q: What does Ann's mother mean? Does she mean Jane is a good friend or a bad friend? (a bad friend)

Argument Story

Tom and Bill were having an argument. Bill would not listen to anything that Tom said, and Tom was getting very annoyed. Tom said;

"Bill, I'm so glad you are listening to my side of the argument!"

Q: What does Tom mean? Does he mean that Bill is listening or is not listening to him? (not listening)

Mother, who overheard the two boys arguing, said;

"Bill, you really are a steamroller sometimes!"

Q: What does mother mean? Does she mean that Bill is listening or is not listening? (not listening)

Individual Data from Relevance Battery

MLD Controls

ID	Idiom (m=10)	Sentence Completion			Irony Stories	
		Syn (m=5)	Sim (m=5)	Met (m=5)	Met (m=5)	Irony (m=5)
150	07	4	4	3	5	4
151	10	4	4	3	5	5
152	07	4	3	3	5	4
153	06	3	3	3	5	5
154	10	5	3	3	5	5
155	00	5	3	4	5	5
156	02	4	5	5	5	5
157	04	4	4	4	4	4
158	06	3	4	3	5	5
159	05	4	3	3	5	4
160	09	5	5	4	5	4
161	06	3	3	3	4	4
162	07	4	4	3	4	4
163	07	-	-	-	4	3

Autistic Subjects

ID	Idiom	Sentence Completion			Irony Met	Stories Irony
		Syn	Sim	Met		
<i>No ToM Autistics</i>						
170	02	4	3	1	1	1
171	06	3	3	2	2	1
172	03	4	2	3	3	2
173	02	5	3	2	3	1
174	00	3	5	1	2	2
175	00	3	1	0	3	1
<i>1st-order ToM Autistics</i>						
176	02	5	4	5	5	3
177	06	4	3	3	5	1
178	03	3	5	4	3	0
179	03	4	4	4	5	3
186	06	4	5	4	5	3
196	10	5	5	5	5	5
<i>2nd-order ToM Autistics</i>						
183	05	5	4	4	5	5
184	10	5	5	5	5	5
185	06	5	4	4	5	5
187	02	3	3	4	5	5
188	09	5	5	5	5	5
197	10	5	5	5	5	5

Appendix IV

Homograph Task Materials

Pretest

bow lead tear row read bat ball glasses letter palm nail bank light

Test

The following sentences were presented in random order.

Rare pronunciation, before context:

There was a big tear in her dress.

It was the lead in the box that made it so heavy.

The man had a second row with his wife the day after.

He took a bow when everyone clapped.

I always read a lot when I was younger.

Rare pronunciation, after context:

The girls were climbing over the hedge. Mary's dress remained spotless, but in Lucy's dress there was a big tear.

The scrap metal man first took the copper and iron and then he took the lead.

The brothers started shouting. Dick left because he didn't want to be involved in a row.

Jack went to the castle to speak to the king. Before he began his speech he made a bow.

Yesterday I read a new story.

Frequent pronunciation, before context:

There was a big tear in her eye.

It was the lead guitarist that sang at the concert.

The man had a second row seat in the cinema.

He took a bow from his violin case.

I read a story now and then I do some maths.

Frequent pronunciation, after context:

Molly was very happy, but in Lilian's eyes there was a big tear.

Mary wanted to take the dog for a walk, so she went to the cupboard and took the lead.

Everyone who wanted to see the new film had to stand in a row.

The Cowboy was fighting the Indian. The Cowboy won because he had a gun, while the Indian just had some arrows and a bow.

First I tidy up and then I read a story.

Individual Data from Homograph Task
Number correct [number of self-corrections]

ID	AGE (yrs)	FREQ BEFORE (m=5)	RARE BEFORE (m=5)	FREQ AFTER (m=5)	RARE AFTER (m=5)
<i>No ToM Autistics:</i>					
170	16.0	5	0	5	1
171	18.9	4	1	5 [3]	2 [1]
173	18.0	4 [2]	4 [2]	5 [1]	4
175	13.5	4 [1]	4 [2]	5	4
190	28.2	5 [2]	1	5	3
<i>1st-order ToM Autistics:</i>					
176	08.9	3	2	3	2
178	17.9	4	1	3	2
179	13.9	5	4	5	5
186	17.6	3 [1]	3	4	4
196	24.6	5	5	5	5
<i>2nd-order ToM Autistics:</i>					
183	17.5	5 [1]	3 [2]	5	5 [1]
184	18.9	5	3 [1]	5	4
185	11.5	5 [3]	2 [2]	4	2 [1]
187	16.1	5	1 [1]	5	1
188	15.3	5	5	5	5
197	25.5	5	5	5	5
<i>Young normal Controls:</i>					
198	08.1	2	3 [1]	5	3 [1]
199	08.1	5	2	5	5 [1]
200	08.2	3	3 [1]	5	5 [2]
201	08.0	4	2	5 [1]	5 [1]
202	07.9	3	1 [1]	5	4 [2]
203	07.8	4 [1]	5 [3]	5 [1]	5 [3]
204	07.3	4 [1]	2 [1]	5	5 [2]
205	07.7	1	2	5 [1]	5
206	07.2	5	1	5	5 [4]
207	07.6	5 [1]	0	5	4 [1]
208	07.5	3	0	5 [1]	5 [1]
209	07.8	4	2 [1]	5	5 [2]
210	07.9	4 [2]	2	5 [2]	4 [1]
211	07.2	4 [2]	3 [2]	5	5